AUGUST 1961 3/6

AUTOMATIC DATA PROCESSING

JOURNAL OF MANAGEMENT AND INFORMATION SYSTEMS

KEEPING MISS OUTSIZE IN STYLE

The role of the accountant
Taking the programmers' eleven-plus
Four computers reviewed

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JOURNAL OF MANAGEMENT AND INFORMATION SYSTEMS VOL 3 No 8

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AUGUST 1961

AUTOMATIC DATA PROCESSING

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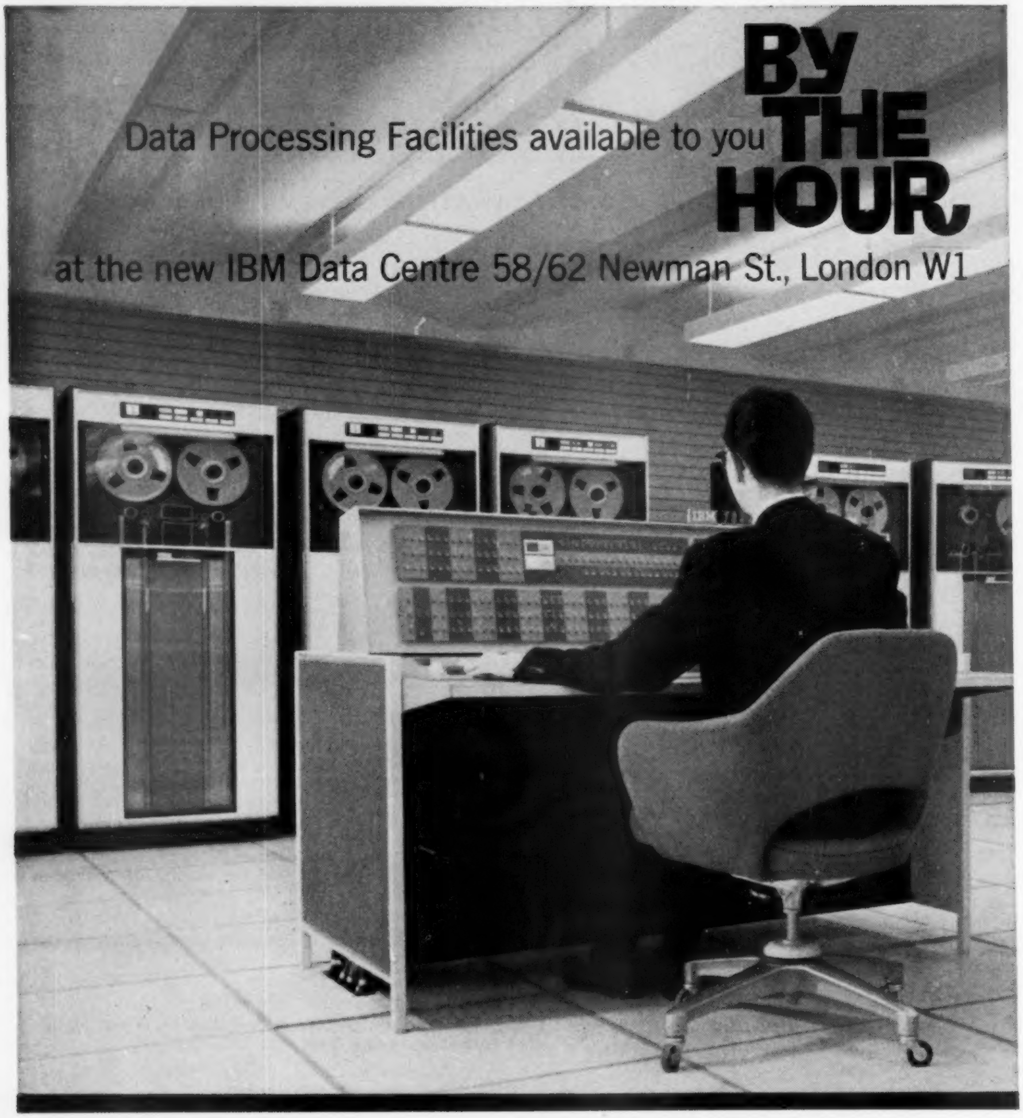

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Recent History

WRITING in the *Times Review of Industry*, under the seemingly alarming title of ' Crisis in the British Computer Industry ', Dr Andrew Booth recently did a little ' stock-taking ' on British computer achievements that is hardly likely to cheer those systems analysts and computer engineers who believe a big future lies ahead of them.

Tracing back who did what first, Dr Booth finds that Britain had at one time ' a clear lead in the production of working computers of modern type ', as university-designed machines were quickly adopted and further developed by industrial firms. By contrast, in the USA companies took longer to gain confidence in the future of electronic computers, but once this was gained considerable resources were poured into the design and production of a range of electronic machines, so much so that one American company—IBM—' soon outdistanced all competitors in the size of their operations '.

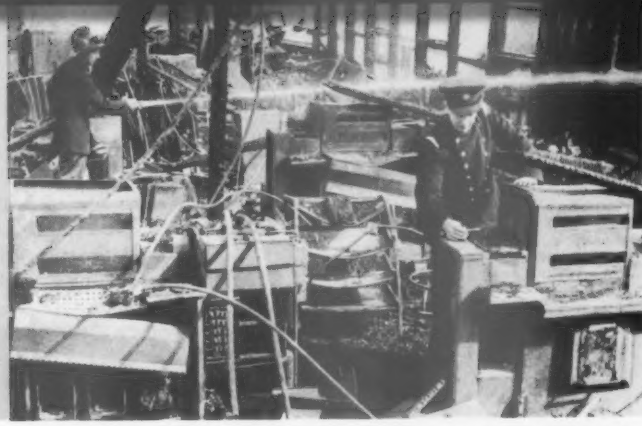
What happened? How did the early starters get overhauled? Dr Booth provides two principal reasons: British manufacturers were slow to tackle ' the vital problems of input-output and peripheral equipment; and British customers, commercial and industrial, have been slow to understand what computers held out for them. Of the two reasons Dr. Booth probably attaches more weight to the second—the could-be computer users who drag their feet, and his concluding remark stresses that:

> British scientists and manufacturers are not backward in the development of new techniques in the computer field. What they do lack however is backing to carry out these researches into large-scale competitive production. This can only occur if British industry and commerce, to say nothing of the Government itself, wake up to the possibilities of using machines and particularly British machines, and so give our manufacturers the support in the next decade which has sadly been lacking in the last.'

Scanning recent history is really only useful if it provides lessons to be applied in the future: history may not set the same examination questions twice, but the syllabus changes little. If we take Dr Booth's first point—that British manufacturers were slow to develop peripheral equipment—another way of looking at this is that the companies did not sink enough capital into research and development, or else sank it on the wrong projects. I only want to elaborate on a part of this suggestion: the effort put into wrong projects. British manufacturers have, with few exceptions, been wedded to the idea of producing big computers (selling at over £100,000) and this will probably be seen to have been a bad bet, because if there was one thing that the manufacturers needed initially was a very large market; and if many companies were saying in 1959 that computers were not for them, it was because they were frightened of the prices quoted.

To say this does invalidate Dr Booth's second point: the lack of awareness in industrial and commercial concerns of what computers offer. Educating management informally—in the absence of formal business education in Britain (in the shape of business colleges) is going to take a long time. In the meantime the leaders of the British computer industry would do well to join the Common Market lobby—for an enlarged market for British computers would produce both short and long term benefits.

DATA DIGEST



Planning the Future

With a computer at your elbow

Mathematical models which afford management the opportunity to gauge the effects that various decisions are likely to have will play an increasing role in business-decision making in the future.

Three new computer programs developed by IBM can be seen as a further move to establish the trend: these programs comprise models to be held within computers, so that, the total effect of management decisions can be 'tested', and in this way unprofitable or inadequate decisions may be seen and avoided.

The first of the programs is for project scheduling: it determines the least cost solution of a production or repair schedule by comparing the factors of time and cost in varying solutions presented to it against a model of the completed operation.

A second program comprises a model of an inventory control system which is subjected to varying demand situations; and the remaining program is concerned with capital investment. It analyses various kinds of investment, such as equipment replacement, plant expansion, take over and amalgamation and research expenditure. It balances anticipated earnings, amount of finance required, the method and terms of finance, depreciation and taxation. The final upshot is a report which enables management to decide on the most profitable level of investment within a predetermined range.

These programs are universal in the sense that they can be adapted to suit varying circumstances in different organisations.

Union automates

Calculator for AEU

Some £67,000 is being spent by the Amalgamated Engineering Union on an ICT 555 electronic calculator and associated equipment to do centralised accounting for the million and more members' contributions.

The AEU has 2,400 branch offices, which send in periodic contributions to headquarters, and one of the first improvements the new equipment will produce is that cash from each branch will be balanced fortnightly instead of every six months.

The new system will begin with books of tear-off sheets containing members' numbers and the amounts paid. The sheets will go to the Union's general office where details will be transferred to punched cards. AEU members will get, via their branch secretaries, tabulated statements of their 'account' each quarter.

After a fire

. . . a face lift for cards

Fire caught hold of the punched card department of a British Railways audit office in Watford recently, damaging considerably the various devices in the department, but it was the firemen's hoses that did considerable damage to the department's card files—comprising 100,000 pre-punched cards: the cards became sodden and expanded and were, it seemed, unusable even after they dried out.

However, British Railways got hold of a Carditioner—a device which 'reconditions' damaged 80-column cards, and it was found that after the cards had been allowed to dry out naturally (an attempt was made to dry the cards by heating them but this made them contract so that column reading was no longer 'true') and put through the device, 90 percent of the cards could be read and used to punch automatically a duplicate library of cards.

Order handling

a system for mail order

Spiegel Inc of Chicago, one of the leading American mail-order houses, have ordered over 200 automatic slip writing machines.

These machines read catalogue details electronically for items ordered by customers and automatically print out sales slips, which can be passed to the warehouse as instructions for extracting and despatching goods. At the same time as the slips are printed,

sales data is recorded on paper tape, which can later be used with data processing equipment.

When a customer sends in an order, the item required is identified by an operator as a single-line description on one of a set of large catalogue cards each carrying 50 such descriptions. (There are 4,000 such cards in a tub-file.) On the back of each card machine-language versions of the single-line descriptions are printed, using black-and-white code patterns.

A card is placed on a slip writing machine with the required single line description against a pointer. The corresponding code pattern on the back is then read photo-electrically and used to activate the print-out mechanism and tape punch. Up to 250 sales slips an hour can be produced.

The machines were developed by Ferranti-Packard Electric Ltd of Toronto, and the order is worth about \$1½ million, which means that each machine is worth about \$7,500 or approximately £2,500.

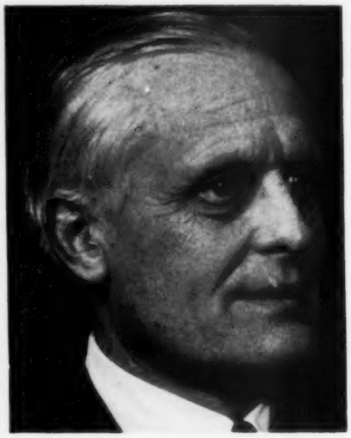
In search of standards

A club for manufacturers?

Already established with headquarters and a secretariat in Geneva is the recently formed European Computer Manufacturers' Association (ECMA) which, with the avowed aim of furthering the adoption of data processing standards among computer manufacturers, promises to benefit the users of computer equipment.

Membership of ECMA is restricted to companies which develop, manufacture and market data processing machines in Europe, and it seems that all the companies that satisfy this requirement have jumped in to join.

Three technical working committees have already been established and their work gives some idea of the contribution ECMA is likely to make: one committee is concerned with codes representing characters for use in computer input and output; another with computer programming languages; and the third with the diagrammatic and symbolic representation of processes. A fourth committee is at present being



HOLLAND-MARTIN
First president

formed to deal with character recognition.

Although ECMA will not, according to its terms of reference, concern itself with equipment, it will be obviously engaged in establishing systems and equipment compatibility, and this work should eventually influence the equipment development of individual computer companies.

ECMA'S first president is Mr C G Holland-Martin, who is ICT's research director.

Cautious Scots

an order after five years

The Scottish Co-operative Wholesale Society Ltd of Glasgow, which acts as a wholesale organisation for the co-operative movement in Scotland, in addition to manufacturing a range of products, has ordered an IBM 1401 computer which, when installed, will play a key part in a re-organised control system.

The computer will be used to control warehouse stocks, corelate statistical information, prepare sales invoices, and for a number of ancillary jobs.

The equipment will not be installed until 1963, and it is reckoned that it will be five to six years before the Scottish Co-operative's reorganisation is complete and the machine is geared to maximum usefulness.

First to be put on the new system will be the Society's grocery warehouse: grocery orders will be punched into cards, and the cards used to check on stock availability as recorded in the computer. The machine will then prepare requisition notes for the issue of goods, provide a sales invoice and maintain sales ledgers.

After the Glasgow grocery warehouse, warehouses in Dundee and Leith will be put on the system.

The society's decision to 'go electronic' comes after five years of investigation; two years ago the Society sent a study delegation to the USA, but the final decision was only taken recently.

Staff training has already begun, so that when the 1401 arrives—it will be equipped with a Ramac disc file and four magnetic tape units—the society will have a nucleus of people trained in computer techniques.

New head

for country house

Bradenham Manor, ICT's country house which serves as a

HART
inherits the manor

computer application training centre, has a new principal—Mr B L J Hart, who succeeds Mr F Worsfold.

Hart, who has a production engineering and work study background (he belongs to the two relevant institutes), was previously with the company's computer group, and has lectured widely on computer production control during the last 18 months. He inherits not only a large and comfortable mansion, but a forcing house of ideas: Bradenham Manor's chief attraction is a small team of bright young lecturers, which includes probably the only symbolic logician employed by a computer company.

Part of Alcan's communications relay setup which links 24 branch offices.

Message network

with relay stations

A private wire teleprinter system established by Aluminium Ltd of Canada (Alcan) provides two-way communications between 24 Alcan offices (as well as connecting, via the trans-Atlantic cable, the company's London headquarters with Montreal and Alcan's North American teleprinter network).

By using punched paper tape, special electronic switching units and tape relay equipment a fair degree of automatic operation is achieved.

The system comprises a tape relay message centre at Alcan's headquarters in London linked to six area offices in the provinces, and messages between area offices are relayed to the London centre which passes them on.

Each area office, which acts as a communication centre for other offices in its area, is equipped with an electronic switching unit, capable of directing messages automatically to their destination under the control of code symbols punched in the message tapes.

This hierarchical arrangement produces far lower circuit costs than would be required if all 24 branch offices in London were to be linked by private line to London.

Initially Alcan intend to use the network for message transmissions only.

On Stream

'Look, no hands'

After several years development work the petroleum industry's first computer control system is now working for Standard Oil Co of California. The system, evolved by research teams from Standard Oil and IBM, was tailor-made to control a particular plant: a fluid catalytic cracker at Standard Oil's refinery in El Segundo, California, which takes oil feed stock from refinery stills and rearranges the molecules to create various high grade petroleum products.

Variables which have to be controlled if the plant is to work efficiently include temperature, humidity, characteristics of flow, the conditions of the catalyst, and the amount of oxygen in the unit.

The El Segundo system scans 75 points of information within the cracker at a rate of 20 points a second, reading continuously, so that new control settings can be calculated within the computing unit of the system and reported to the cracker operator.

In addition, however, the operator can switch the system so that it changes the plant controls automatically in response to its own calculations.

Midland order

One computer for 60 branches

Over 100,000 current accounts in 60 branches of the Midland Bank in the London area will be continually updated by computer when the bank instal a KDP 10 system in the autumn of 1962.

The system, to be supplied by English Electric, will cost £250,000. The bank will establish a computer centre in the West End, and will equip the 60 branches with accounting machines which produce punched paper tape as a by-product. Current account records will be held on magnetic tape at the computer centre, and these will be updated daily with the data on paper tapes. High-speed printers will produce statements for customers and the branches in one operation. It is estimated that the 'sort and post' operation to update current account records for the 60 branches will take no more than four and a half hours a day.

The centre will be staffed by 10–12 people.

Linking machines

. . . via a compatibility box

Magnetic tape 'translators' which will provide continuous 'on-line' compatibility between Honeywell computers and IBM

The fastest Leo yet in harness soon!

LEO III, the latest and fastest LEO Automatic Office, will start service trials soon, in preparation for the opening of the fourth LEO Service Bureau in London on January 1st 1962. LEO III, incorporating every significant advance in commercial data processing, will make available the LEO service to a still wider circle of businesses—both large and small.

Six basic facts about Leo III

1. Magnetic Core Store of up to 320,000 digits, automatically shared amongst several concurrent jobs.

2. Special buffering arrangements between computer and input/output equipment to enable all to work continuously.

3. Comprehensive and extendable order code, with ability to calculate automatically in binary (fixed or floating point), decimal or sterling numbers, according to the particular calculations.

4. Fast printing—up to 60,000 lines per hour. Fast magnetic tapes with unsurpassed built-in error detection.

5. Fully transistorised circuits, with checks at all transfers, high reliability and the fullest attention to ease of operation and maintenance.

6. Made up of independent units which can be added to on site as needs increase, without interrupting routine operation.

Six jobs Leo III will be doing

1. **Invoicing, sales control, sales analysis and sales forecasting**
2. **Stock and warehouse control**
3. **Production scheduling and control**
4. **Payroll and wages costing**
5. **Engineering and Market Research calculations**
6. **Stock Exchange and Insurance Accounting**

LEO has been giving hour to hour service for 7 years now. LEO III will make this service faster and wider than ever before.

MORE FACTS ?

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LEO III

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systems have been developed by the electronic data processing division of Minneapolis-Honeywell Regulator Co.

The translators enable Honeywell 800 and 400 systems to work with tape written by IBM machines and to write tapes acceptable to IBM machines.

A translator for the 800 system will rent for approximately £630 a month and one for the 400 system for about £320 a month; to buy outright the translators will cost about £30,000 and £14,000 respectively.

Designed to provide continuous interchangeability of data between the two makes of computers, Honeywell envisage a translator would be useful in large organisations that operate computers of varying types and capacities at decentralised locations; in cases where two or more organisations using different EDP equipment wished to exchange data held on magnetic tapes, a translator could also be useful.

Run repeated

. . . after bandits called

Bandits snatched the pay packets of 700 night shift foundry workers at the Ford Motor Co's Dagenham works recently. As the news of the robbery came through, the manager of the computer operating department, realising that a new payroll would have to be prepared, had all the payroll data fed into the computer, and produced within an hour a duplicate payroll for 2,100 day and night shift foundry workers. The payroll for the day shift men, who had been paid before the raid, were separated out, and 700 new wage packets were made up. Thus the night shift men were paid only a few hours after paying-out time.

Ford operate two Leo computers—the one at Dagenham, and one at their spare parts depot at Aveley.

Publications received

Some Commercial Autocodes. A comparative study of autocodes prepared by a team of five and published for the Automatic Programming Information Centre of Brighton College of Technology. Comparisons are made in tabulated form. Academic Press. 15s.

★ ★ ★

British Commercial Computer Digest. A digest of information on computers and data processing machines available in Britain prepared and published by Computer Consultants Ltd. Bound in loose-leaf form so that additional data sheets can be introduced. Additional data sheets are available free for one year and thereafter by taking out an annual subscription with the company. Computer Consultants. £5 5*s*.

Briefer Notes

. . . Senior Staff Consultants Ltd have formed a special department to deal with recruiting and appointing staff for all aspects of computer work. They have taken over the staff appointment service previously run by Computer Consultants Ltd, who will be retained to advise the new department.

. . . Litton Industries of California, USA, have acquired London Office Machines Ltd, who were previously agents for Sweda machines (produced by a Swedish subsidiary of Litton). Litton already own Monroe Calculating Machine Co Ltd and A Kimball Ltd.

. . . Renault of France have just installed an IBM 7070 computer. It will be used for production scheduling and control, budgetary control and market analysis, and will process every two weeks 400,000 work tickets to make up a payroll for 35,000 employees. The 7070 was built in France.

When automation comes

Predictions of what will happen when automation comes—rather than reports on what does happen—were the fare at a recent conference on the subject of 'Automation—Men and Money' organised by the British Conference on Automation and Control.

'So far, so good—but not nearly far enough', so one delegate summed up the BCAC conference at Harrogate on the social and economic effects of automation. The nineteenth-century spa with its aura of wheelchairs and gentility and its comfortable Victorian hotels sheltered by tall trees seemed a strange setting for a discussion on the apotheosis of technology. Yet, the remoteness fitted in with the mood of intellectual abstraction as speakers and delegates tried to anticipate the future from a minimal range of practical experience. As Lord Hailsham remarked in his opening address, at this stage we could do little more than think out the problem and ask the questions.

The accent of the congress

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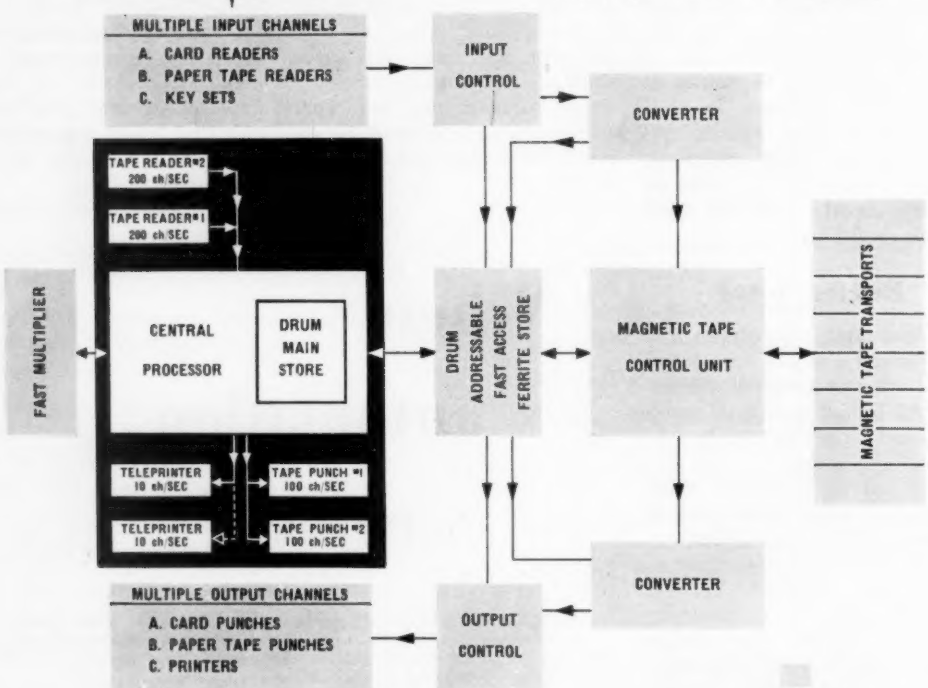

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tended to be on the human aspects, but time and again it became clear that all the implications of automation, technical as well as social, economic as well as human, were so interdependent as to make impracticable the drawing of any sharp distinctions. Questions about wage-rates, for example, were linked technically to demands for new levels of competence, and economically to the need for absorbing increased production. Practically everyone stressed the need for more research by social scientists on the effects of automation on people in industry, but research is impossible if the material is not already there in the form of numerous instances of fully automated processes. Research cannot go far enough because automation in this country has not gone far enough.

What did the conference establish? First, for economic reasons, automation must come to our factories and offices as quickly as we can assimilate it. Mr J A C Brown of Cambridge University pointed out that our Gross National Product was far from achieving the rate of growth of that of the six countries of the Common Market, and, as our birth-rate is slower than that of other countries, we are entirely dependent on an increase in labour productivity to maintain economic health. The limit on the pace of extension will be set by the pressure on certain sections of industry, particularly the electronics industry, and by the unsatisfied demand for certain types of highly skilled labour.

★ ★ ★

All parties having agreed on the necessity and desirability of automation, the emphasis at the next logical but not historical stage of the conference switched to a plea for caution. Partly, this meant caution about finance, the need for detailed analyses of sales data, cost analysis, cost determination, reduction of variety either in range of products or product-components; mainly, though, the emphasis was on caution about people. Full consultation with employees before the introduction of automation was urged by speaker after speaker. Prior consultation, we were told, by representatives both of trade unions and management, should not be confused with prior notification. It meant rather the complete participation of employees in deciding the methods and speed of transition to automation.

★ ★ ★

The last stage of the conference reinforced this plea for caution by embarking on a discussion of the magnitude of the changes we can expect. Nothing will be the same, Lord Hailsham had said. What sorts of changes were likely? First, we were assured of a quantitative and qualitative change in the nature of the working force. Fewer, but more skilled, operators of whom less will be demanded in the way of physical effort, but who will be exposed to much greater mental stress; an increase in the numbers and the technical know-how of maintenance staff: the growth of clerical and administrative employees and the disappearance of the already outmoded distinction between staff and works. We can expect simplified wage-structures to accommodate the new-found professionalism of the working force and we shall find a complete shift in the social equilibrium of industry as a new technical élite emerge and the old class of semi-skilled workers are absorbed into the swollen clerical group, whose task it will be to accumulate the data which will keep the automated factories running in step with demand.

The second change will be in the structure of the industrial organisation. On this, we had two views. Mr Tom Burns of Edinburgh University envisaged a flexible 'organic' structure as being best adapted to the demands of at least the transitionary stage. Instead of jobs which were precisely defined, everyone in a concern, especially members of management, should be committed to the solution of problems as they arose and be willing to take decisions. People should learn the 'language' of their colleagues so that nothing should inhibit individuals from applying to others, irrespective of status, for information advice or additional effort. Dr Lupton, Head of Industrial Administration at the Birmingham College of Advanced Technology, looked forward to what was perhaps a later stage, where, as a result of integrated data processing, detailed information and complete power would be concentrated in the hands of far fewer executives at the top. Specialist executives and many managers would find their area of discretion curtailed as information became more adequate and decisions except at the highest level were confined to verifying exceptions to the smooth productive process. Heavy responsibility would be placed on line management for collecting information within a strictly defined area and passing it up.

This last stage of the congress was the most startling and, consequently, the most valuable for the way in which it impressed on everybody present the need for complete rethinking about a situation where traditional concepts have only nebulous validity. However, there was quiet optimism that, on this occasion, the machine will not dictate our moves as it did so disastrously at the time of the Industrial Revolution. The reason for this is that we probably do not expect so much so easily from the Second Industrial Revolution as did our forefathers from the first. Perhaps the delegate would have done better to sum up by saying, 'So far, so good, but keep watching it'.

HOWARD GRIFFITHS

Keeping Miss Outsize in Style

Maurice Chevalier in the popular song thanked Heavens for little girls, but in the fashion world it is the big girls who thank Evans Outsizes, who market smart clothes in their size, using a Kimball system to control stock and sales analyses.

David Roach Pierson

FOR a quarter of a century—they celebrated their silver jubilee in March of this year—Evans Outsizes Ltd, the drapery chain store, have been ' thinking big ' in women's fashions. In March 1936 the first Evans shop, devoted exclusively to supplying women with a hip size of between 42 inches and 60 inches, was opened in High Street, Kensington, London. W.8. Until that time outsize women had been catered for only by a single counter in the bigger departmental stores, where the range of goods was limited, and where fashion clothes were simply blown up versions of the current models for smaller sizes. There was a need for a shop devoted exclusively to the requirements and the problems, fashionwise, of the larger woman. The response was immediate; it was clear that all over Britain there was scope for expansion to meet the needs of women with expanding girth, and for fashions suitable not only for middle aged but also for young girls of large dimensions. Self conscious ladies were delighted to be told ' Size 46, madam? Why, that's one of our smaller sizes! ' By the beginning of this year, Evans Outsizes had expanded their business and were retailing from 35 branches; the 35th branch, at Leicester, was opened in April, and since has been selling well above expectations. Weekly sales from the branches now average about 30,000 items per week, and the turnover of sales has increased steadily over the past few years by about 30 percent per annum.

EVANS' RANGE

Like any other fashion chain store, Evans sells a wide range of goods, for several age groups, and in several styles. Almost the only clothes not sold are shoes, gloves, and hats; and these items were in the Evans range right up to the war. Goods sold are classified under ' departments '—a classification very important for stock control purposes; there are six of these departments, covering cheap and expensive dresses, coats, skirts, blouses and knitwear, and underwear. This last item is probably the most important, in terms of stock control. Of the 30,000 items sold a week between 10 and 12,000 items are from the underwear range.

The marketing of goods, and the control of stock, is planned very meticulously on a seasonal basis. Every branch is assessed on the basis of the previous year's sales figures, and the knowledge of market trends in the fashion world. Goods are then allotted by the central stock controller to branches. The important thing in these calculations is to maintain a balance between demand and supply, so that there is not a lot of dead wood in the branches in terms of unsold stock, nor a shortage of goods. This means that stock levels in branches have to be

carefully watched, and re-ordering and inter-branch transfers maintained on the basis of information received. It is clear that some branches will do better than expected and some worse; it is probable that certain lines will sell better in Birmingham than Newcastle, etc. All these tendencies must be watched at head office by the branch stock controller, who must hold all the strings of the network under his hand. The method of maintaining control in Evans Outsizes over stocks and sales is by the Kimball tag system.

THE METHOD

The Kimball tag method is widely known. Introduced first in America for retail sales and stock control in big departmental stores, it has been adopted in this country in a number of large chain stores. The basic idea is that all details of the item to be sold are pre-punched on a sales tag, which is attached to the garment when it leaves the warehouse. The tag or part of it, is sent back to the accounting department of the store when the sale is made where it can be read by a special reader and converted into an 80-column punched card, and processed on a punched card complex to give sales and stock analyses. The tag consists of a miniature punched card $1\frac{1}{8}$ inches by $2\frac{1}{2}$ inches and is some 0.013 inches thick. Some 24 digits of information—numerical in the case of Evans', though alphabetic information can be used in certain cases—can be punched into the card, and simultaneously printed out lower down on the card.

The key to the stock control position lies in the call number—or style number—which is allotted at the beginning of each season by the stock controller to each sales line. There will be some 200 call numbers allotted over the season. The call number is a four digit number relating to the branch, the season, the colour and the department of the unit garment. Every branch has a single digit number allotted to it, so that every call number with an initial number of 5 relates only to a particular branch. The first two digits refer to the season, the next digit to the department, and the last digit to the colour.

Each of the departments—or types of garments—has a single digit number allotted to it for the season. Thus for the Spring 1961 cheap dresses are designated by the number 4, coats by the number 5, underwear—which is not affected by seasonal factors—is given 0 as its number; the blouses and knitwear departments are given 7; shirts, slacks and jackets department is given 6, and the expensive dresses section is given 8.

In addition to the call number, a single digit code number signifying the type of material utilised is also entered on the card. This also is allotted at the beginning of the season. These two numbers take up the top line of the two lines of punching. The second row of punching is taken up by the price—nine digits—and two digits for the date. This is in fact the first, second, third, etc, week of the season.

The various numerical codes are both printed and punched on the Kimball Ticket by means of the Kimball 75 punch printer. This printer is housed in a special partition attached to the branch stock controller's office in the Kensington Head Office. The printer punch is a machine about the size of a sales register operating continuous stationery, a control panel being located on top of the machine where the form bed would be. The control panel has a manual setting slide for each of the 24 digits of information which can be printed and punched. A panel at the head of each slide indicates to the operator when the digit he wished to punch has been set. When all the slides have been set up, the operator will adjust the control knobs at the top of the panel to signify the number of tag sets (from 1–999) which it is designed to print/punch with this numerical combination. Finally, the operator fixes the number of tags to a set. This controls links up with a guillotine which chops the tags into the required sets as they pass out of the machine.

When the setting is done the operator feeds a continuous strip of tags into the feed slide and presses the start button. The tags are punched with the information according to the control setting. Punching is done on all holes simultaneously, according to a binary punching code.

By this code every digit has four possible punching positions, the four holes representing 1, 2, 4, 7. In this way any number from 0–9 can be represented by one or two punching holes. Zero is indicated by punching both the 4 and the 7 positions.

All the punchings are carried out simultaneously and at the same time the printing mechanism prints the punched information on the tag in clear language. This punching/printing operation is carried out at a speed of up to 10,000 tags per hour. The tags proceed in continuous form to the output slide where the guillotine separates them into the designed sets of two, three or four—Evans operate with a duplicate tag set—until the pre-set total of tag sets required is reached. The machine will then stop automatically.

THE ROUTINE IN EVANS'

The cards are made out from a copy of the order to manufacturers. When the goods come in from the supplier the copy order is passed to the ticket punching section where the details from the order are converted into tag form, duplicate tags being attached to every item. The goods are then sent to the branch identified by the first digit of the call number. At the branch the size of the garment will be extended in writing on the tag.

When the sale is made at the branch, one segment

of the tag is detached and given to the customer as a bill. The cashier stamps on the reverse side of the cards the serial number relating to all the sales made that day. This means that in order to defraud the system there must be connivance between cashier and sales assistant. The cashier will then put the tag on a spike, so that sales records are accumulated in sequence, ready to be sent to head office at the end of the day.

PROCEDURE ON RECEIPT OF THE TAGS

The tags arrive at head office the day following the sale made at the branch, together with the sales summary and the record of cash banked. The first use to which the cards are put is to produce a daily analysis of branch sales—both total sales by branches and sales by department and by branch.

The tags are passed to the tabulating machine department where the information on the tags is transferred to 80-column sales cards. The machine department contains the Kimball Tag reader cable connected to an IBM 523 reproducing punch; an IBM 420 accounting machine with a 521 summary punch; and automatic card punches and verifiers, IBM 024 and 026, for punching details of goods purchased from suppliers, transfers, etc. In addition there is an associated sorter and collator to assist the tabulating operation.

The tags are threaded on to the spindles of the Kimball reader and placed in the input magazine of the reader. The cards are sorted by a group of wires being brought down into contact with the card; where holes occur electrical contacts are closed, and relays are energised to control the punching into the 80 column cards.

The 80 column cards would thus be punched with the branch number, department and call number, type ie. material and selling price. A special one-digit column would also be punched to signify that this was a sales card. Only 40-columns of the card are used at any one time, the cards being later re-inserted to utilise the other columns as a separate sales recording operation. Cards are punched at a speed of 100 cards per minute on the 523 reproducing punch. The sales cards are then run through the 420 tabulator to provide a daily analysis of sales by call number and by branch. These totals will be checked against the sales-summary and cash banked for reconciliation. The cards are then filed by department and branch and accumulated until the end of the week.

At the same time the details of purchases and transfers affecting the branches are also accumulated. A yellow-edged card is prepared on the automatic key punches from the goods received copy of the supplier's invoice. These cards would be filed by department and branch to signify accretions in the branches' stocks. Also prepared on the automatic key punch are the details of the transfers from one branch to another, which affects the stock position of branches. By Saturday there would be in embryo a complete record of stock movements which would be required to merge with the stock balance card for each branch to establish the updated stock position.

The stock balance card which is prepared as a by-product of each week's stock and sales analyses, contains details of branch departments stock by call number, type and selling price of goods. In addition it carries four columns for quantity of goods in stock, and five columns for the sales to date. In addition for comparison of various manufacturers lines, it would carry three columns for the manufacturer's house number.

The cards would be collated, sorted and merged into branch and department order, with the stock, balance summary card heading the sales and purchase cards. The first requirement is to produce an updated stock balance of all items by branch and call number. Next a detailed analysis must be prepared of each garment by branch. A consolidated analysis can be prepared of total sales per branch, aggregate sales, and stock held per call number. This information will be held on a single summary card and later used for monthly analyses.

The great advantage of the Kimball system, say Evans', is that the management and stock controllers can be certain that they will receive their weekly analysis for certain on Wednesday afternoon at the latest 'Under the old system' said Mr Cummins, the branch stock controller. 'We weren't really coping. The sales analyses would perhaps be ready by Wednesday—some of them at least—and then we would have to wait for a day or more for them to be typed. Now we can get more detailed analyses covering more branches in very much shorter time. In peak periods we used to have six clerks working overtime, and we still used to fall behind schedule. Nowadays even with underwear, which sells at a rate of 12,000 items per week, we can be certain, even in peak weeks, that we shall get figures out by Wednesday evening.'

The cost of renting the combined IBM-Kimball equipment is approximately £4,000 per year. In addition the machine section staff of four must be taken into consideration. But though this system costs more than the combined Cardex-Tickopres system which it replaced, Mr. Cummins does not consider the extra cost excessive. 'We have been able to cope with additional jobs—notably the analysis of the daily sales of all branches, which was previously done in the accounts department. We reckon to be able to cope with an anticipated sales rise of 30 percent and for the opening or expansion of new branches, which happens about once a year. In fact two new branches have been installed since we started the system, and we took them both in our stride!'

From the Examination Room

On Not being a Born Programmer

Robert McKinnon

WHEN the editor asked me to go along to IBM head office in Wigmore Street and take the company's aptitude test for would-be programmers, my mind went back to the first time I saw a computer program. There, in all its cold, precise beauty, it lay on a desk in an ADP control room; 2,000 steps of cabalistic symbols, each a logical development from the preceding step, and each group of steps dependent on the previous group.

I was quite overawed, and I thought of Hazlitt's observation on the performance of some Indian jugglers whom he had just witnessed. He asked himself if there was anything in the world he could do half as well as these jugglers performed in their own branch of expertise.

'Of course,' said the programmer, 'I didn't write it in an afternoon. It took me quite a few weeks.'

I would still have been impressed had he told me that it was the work of a lifetime, and ever since I have looked upon programmers—as I do nuclear physicists, orchestra conductors and sword swallowers—as men apart, as being invested with well-nigh superhuman powers.

Yet, I would argue, the advertisements for trainee programmers often ask for only sound logical powers and mathematics up to 'Ordinary level' standard. Was it possible, then, that I, too, could have been a programmer? Could I also, in this sense, have become one of the 'elect'?

So, my mind a decent compromise of curiosity and humility, I went along to IBM where I was introduced to Mr D C Godsland of the Personnel Department who looks after the recruiting of programmers. Before giving me the test, he told me what it was all about.

The test, Mr Godsland emphasised, was by no means the be-all and end-all of the selection procedure, but it was an objective means of assessing an applicant's reasoning ability. However, other qualities such as personality, academic background and business experience were equally important, and these were assessed at further interviews. The company was confident nevertheless that their test was a satisfactory method of measuring basic aptitude for programming work, and no one who failed—unless there were some exceptional mitigating circumstances—was considered for further training. And, Mr Godsland pointed out, of the 40 percent who do pass by no means all are offered jobs.

IBM have been using this test in the USA and Britain since 1957, and something like 12,000 people (including some 4,000 customer employees) have taken it; results from the two countries, by the way, have proved practically identical. The test is used only in the selection of programmers and company data processing systems salesmen who are expected to know something about programming. Both

groups are of course given thorough training after acceptance; in the case of programmers, the training lasts 12 months and consists of six months' theory and six months' practical.

The test consists of 86 questions grouped in three sections: number series, figure analogies and arithmetical reasoning. Time allowed is one hour, and the standard of mathematics required (so I was assured) is that of a 15-year-old schoolboy of reasonable intelligence. There is one mark for each question and, in the sections on series and arithmetic, five alternative answers (including the correct one) are printed after each question. This, incidentally, helps the inspired guesser but is apt to panic the logical plodder if his answer does not square with one of those printed.

From a total of 86 marks, a score of 60 and above gets an A classification; 50 to 59 earns a B, 40 to 49 a C and 39 and below puts one down among the Ds. Answers are indicated by putting pencil ticks on a separate pre-printed form. The examiner covers this with a special piece of punched paper whose holes fall over the positions of the correct answers—in other words, no tick no marks. In this way, a paper can be marked in a couple of minutes.

Briefed and armed with the necessary documents, I was shown into an empty office. In no time at all it was quite apparent that the test had been devised by a mind of infinite cunning, a mind which should be earning its owner large sums of money for compiling television quiz programmes, if such is not already the case. Section one—on number series—lulls one into an early complacency. After all, even a journalist knows what number follows 2 . . 4 . . 6 . . 8 . . 10 in arithmetic progression. But by the time one reaches the 20th question, one is adding 7 then 11 subtracting 2 adding 5 then 0, then taking away the number one first thought of. Of the 26 questions in this part, I managed to do 18, and by this time was expecting the worst.

Section one was clean, healthy fun compared with the next section which, as stated, rejoices in the title of ' figure analogies '.

Have you ever seen the commercial television programme called *Pencil And Paper* or been silly enough to attempt the I.Q. test in the Eleven Plus? If so, you will have seen these questions which give you a relationship between two crazy geometric patterns, then ask you to find a mate for a third pattern from a selection of five or six further patterns.

Well, section two contains 40 such questions to be answered in 20 minutes, and of course the examples are subtly built up from the simple to the cubist's nightmare. One starts off with triangles and graduates to an orgy of circles, ellipses, polygons, dots, tangents, rhomboids, plain, shaded or striped according to the whim of the compiler. My score here was 23 out of 40, and I'm proud of it!

Section three, ' arithmetical reasoning ', was quite straightforward provided one has plenty of scrap paper. There are 20 questions to be answered in half-an-hour, and none of them is really difficult provided they are read carefully. But it is just as easy to misread the questions and make silly errors. Though I finished with time to spare, I for one made the elementary mistake of not bothering to check the questions or my answers.

Although there was nothing at stake beyond mere vanity, I was as excited as a schoolboy while my paper was being marked. The pretty secretary who came back with the result was most diplomatic. I had got 54 questions right out of 86, and according to my reckoning this is a solid, no-nonsense 62·79069 percent. And as one hears on all sides these days that the younger generation is practically illiterate, I could have been forgiven for thinking that IBM might have signed me on there and then.

These, however, are also the days of the psychologist and the statistician, so the marking was not quite as straightforward as that. My score was standardised by a formula which, by deducting one quarter of my errors from the total of correct answers, reduced it to a miserable 46 which placed me in C stream. The company is interested for this particular job only in the As and the Bs.

I have of course my excuses to fall back on, and, in order of importance, I would set these out as follows:

1. Having at one time or another mastered, or attempted to master, the Binomial Theorem, the Quantity Theory of Money, Kant's Categorical Imperatives and the first steps in Binary Arithmetic, my mind was protesting against being overloaded at this late hour;

2. The sun was shining direct on to the white paper and back on to my glasses, so I could not be sure that I was seeing the crazy patterns in section two as they really were.

3. As I had not sat an examination or test of any kind for nearly 15 years, my technique was rusty. For instance, it did not occur to me until afterwards that I could have cheated on the section on number series in one of two ways. I could have ticked the remaining eight questions at random just before the invigilator told me to stop; or I could have completed the section when I had a few minutes to spare at the end of the test.

4. I kept thinking of the story I was to write about the test.

Yet in all seriousness, this particular test does go right to the blind spots in a person's reasoning ability, and I have to face up to the fact that IBM would be wasting its money were they to try and train me as a programmer. They would do well to keep me away from their data processing machines.

Ah well, I still have my typewriter!

The Role of the Accountant

Abstracted from an address made by Eric A Leslie, vice president for accounting of the Canadian Pacific Railway, at the annual convention of the General Accountants' Association of Canada, this article should inspire British accountants and disturb others.

THE subject selected for me, ' The role of the accountant in electronic data processing', is a challenging one. Fortunately, the title is vague as to whether the ' accountant ' referred to is one who follows the auditing profession or is a person, with or without professional training, who occupies a position in an accounting department.

In order to address myself to both groups, I have divided the role of the accountant, about which I am to talk, into four main functions:

1—general accounting and control
2—internal audit
3—professional external audit
4—general business intelligence

The first three of these functions are changing rapidly, but in more or less traditional fashion. However, the fourth—general business intelligence —is now undergoing revolutionary changes.

Electronic data processing [EDP] makes possible a new concept of data processing—' integrated ' data processing. This concept involves much more than simply using new machines to perform old tasks. It can change the whole basis for managerial control. To exploit it properly, one must be prepared to alter one's thinking and approach entirely.

I still recall vividly, while in high school, being taken in 1912 to see a Hollerith vertical sorter and a tabulator handling 45 column cards with round holes. It was located in a tiny space in the small tower of Canadian Pacific's Windsor Station and was the pride and plaything of the Auditor of Freight Receipts of that day. The variety of business machines increased rapidly in the succeeding 25 years and there was a steady growth in use until, in the late 1940s, the first electronic computer, a small affair, appeared. The Canadian Pacific installed its first in 1949 and considered that a new era had dawned. It was not, however, until 1951 that business data, as opposed to strictly accounting data, commenced to be fed into computers, and it was not until 1954 that any corporation began to use a large scale unit. During the next three years, as you will recall, growth was phenomenal—some 200 large scale computers and more than 800 medium scale types went into service. Now, in 1961, there are some 575 large scale, and 4,900 medium and small scale computers in use. A quite recent development is the appearance of small but powerful transistorised computers that bring an effective EDP system within the cost and requirements range of smaller firms.

The data processing requirements of the big companies seem to demand more and more powerful models and these are becoming available. The Canadian Pacific, for instance, is now getting ready

for its fourth high speed computer, an IBM transistorised 7080, due in October. This will be six times faster internally than our present 705 model and, we expect, will be adequate for many years to come.

Against this background of development in machines, let us consider in turn the four accounting functions under which I suggested these remarks would be organised.

Impact on the general accounting and control function

It has been said that EDP has not changed any of the fundamentals of accounting. These remain the same. The change is a physical one affecting the manner in which accounting tasks are performed. The mammoth clerical operation involved in collecting, summarising, accumulating and posting individual records to bring them together into useable form is now done mechanically.

In our own case, for example, mechanisation begins with recording the revenue information from the waybill at or near source, carries through to a computer match with final settlements at destination, and proceeds through successive stages until the transaction is reflected in a mechanically produced General Ledger of the company. In the process we have more comprehensive controls than previously.

The old clerical operation represented a major portion of the effort of any accounting group. Company accounting personnel were, in a sense, largely data processors. With this chore largely removed, in future their prime accounting function will be that of control and analysis. Analysis can, in turn, be greatly facilitated by EDP. The computer makes possible much more informative analyses of results—analyses which would be prohibitively expensive in terms of staff time if produced clerically—and, what is more important makes it possible to deliver them in time to be of use in current, as well as long range, planning of the operation of the business. I shall have more to say about this presently.

Impact on the internal audit function

This brings us to the second function—internal audit. Although the purpose of audit is not changed, the manner of its achievement is also drastically changed by EDP. The main problem is the creation of an audit trail when confronted with the invisibility of records.

No matter what methods of record keeping are

CANADIAN PACIFIC'S NETWORK SYSTEM

As background to his remarks on the role of the accountant, vice-president Leslie outlined some of the data processing methods employed by his own company:

Early in 1955, Canadian Pacific adopted the comprehensive approach to processing freight information within a general company-wide plan to serve all departments. The method is to record information in mechanical form at source, or as close to source as is practical in terms of cost, time and techniques. Once recorded in mechanical form, data are processed entirely by mechanical means. New information pertinent to that already recorded is itself recorded in mechanical form as succeeding events occur, and is integrated with the existing record. The output—processed information—is designed to meet the final requirements of all users. 'Final requirements' means that the recipients should be able to use the output with a minimum of further processing on their part.

The nature of the business dictated the physical set up: machine equipment is installed at 68 of principal yard offices from coast to coast, with teleprinter transmission between adjacent yard offices and to one of the four regional data centres established at Montreal, Toronto, Winnipeg and Vancouver. The mechanised yard offices serve as recording points for data originating in their locality and as receiving and distributing points for data received by wire from adjacent yard offices or in feedback from the data centres.

Three of the four regional data centres are equipped with fairly extensive conventional machine installations. They transmit information from field offices to our main computer centre in Montreal, do some processing for regional purposes, distribute processed information received in feedback from the computer centre to regional offices, prepare the first mechanical recording of source information for some of our IDP applications, and do mechanical processing for Canadian Pacific subsidiaries. Processing and other machine functions for the fourth regional data centre, are handed by the computer centre in Windsor Station.

This Centre has the most comprehensive complex of data processing equipment in Canada.

Following the data abstracted from the waybill—the principal source document covering rail freight

business—gives an idea of the system. Waybill information required for all purposes is recorded in the field office, transmitted to the data centre and relayed thence to the computer centre, where it is maintained on magnetic tape. At the field office, a paper tape containing only those portions of waybill information required for movement purposes is produced as a by-product of the original recording and filed for subsequent use. When trains are assembled, information covering the locomotive, crew, tonnage, etc., is punched in a tape and pieces of tape for each car are selected from those previously filed. These are used to produce a new continuous tape from which to print out a ' train consist ', in the order in which the train is marshalled, for the conductor. The tape with ' train consist ' information is then transmitted to the data centre and simultaneously to the next yard office where it is used to plan switching operations. At the data centre, it is used to give train and car movement information to regional offices. It is also relayed to the computer centre where it is matched up in the computer with data received previously. This process is repeated each time the car moves and when any new event affecting it occurs, such as diversions, trans-shipments, etc. Once each day, all these data are processed so that magnetic tapes are available before the opening of business. These contain a continuously up-dated record of the physical status of all wagons as of a cut-off time a little after midnight. This record, which, of course, was never before possible, is the foundation from which other processing produces outputs to meet all requirements of all departments.

Up-to-date data on the wagons in which they are interested fan out daily to operating and traffic officers all over the continent. Each day 100,000 records pertaining to 105,000 units of equipment, of which track must be kept, are received. These records are taped, transmitted, processed, analysed and assembled in reports for operating, transportation, traffic and accounting purposes at various levels and for government reports.

In contrast, the old method was for each department to extract data to serve its own needs. A great deal of duplicate manual processing of information took place and progressive summaries were transmitted from one departmental level to another. Under EDP, the main data transmission and summarising is done in a unified or integrated flow stemming from the original mechanical recording.

This, of course, completely alters the basis and timeliness of management control information. The old basis resulted in the transmission of a limited amount of information through a number of departmental funnels, up from below. By the time the diversified and often unreconcilable information was brought together manually at the top, it could be the subject of many arguments. The new basis provides for a single integrated flow, with the output appropriate to each level and particular purpose coming mechanically from a common source, so that the basic facts behind the information furnished all departments can be the same and, often, much more comprehensive.

In terms of the new concepts, the Canadian Pacific program is now at a very interesting stage. The company have developed a working integration of transportation data collection and processing over a very broad field. From the freight information now available to them on magnetic tape, they believe they should be able to provide the most sophisticated control information management can ask for.

employed, internal auditing in any organisation presumably will continue to revolve around two principles:

(a) the establishment and maintenance of built-in controls within the system.
(b) the checking of records after entry to ensure accuracy.

In the past, under manual procedures, internal audit saw to it that the traditional concept of divisions of responsibility was carried out—ensuring that no single individual was involved in the control of recording a transaction right through. One authority would originate charges against the company's debtors, a second would record them and prepare the bills and a third would receive and record the settlements. This type of organisation makes collusion necessary before a fraud can be perpetrated, and the internal auditors did sufficient checking to see that this was not likely to occur.

Establishing controls with EDP systems is somewhat different. A characteristic of EDP is that far fewer people handle a record—in fact, EDP planners are striving to have the fewest possible people handle records. This makes necessary more emphasis on ensuring that records at the point of entry into the machine processing procedures are accurate, authentic and complete, and that the machine processing itself is sound in all respects.

Two new responsibilities for the internal auditor which, incidentally, he shares with the external auditor, are:

1—to learn and apply what the new machines can do for him in the way of providing, mechanically not merely the audit controls which he formerly developed manually, but completely new tools for audit work. He should be interested in the possibility the computer offers for 100 percent. audits that can be built into procedures as a by-product, and for entirely new audit criteria.

2—to ensure that audit requirements in the form of printouts, and opportunities to match them with selected original documents are incorporated in the new procedures.

He will find, too, that he has to move a little faster. Magnetic tapes, with all the details, are not preserved indefinitely. His checks and audits must be made when they are still available, and his requirements must not involve unduly long retention or excessive machine processing time.

From what I have said, you will readily appreciate that each application will require its own special brand of controls. May I add that our experience to date would seem to indicate that EDP simplifies the internal audit function rather than the reverse.

Impact on the professional external audit function

As mentioned above, the problems of the third function, professional external audit, are closely aligned with those of internal audit in ensuring that adequate internal controls exist and have the desired effect, and in ensuring that sufficient records are produced at various stages in processing to allow subsequent tracing through of transactions.

To enable the external auditor to express an opinion of the financial statements, he must satisfy himself as to the accuracy of the accounting records, that no fraud has been committed and that generally accounting principles have been followed. It would be presumptuous on my part to outline how this function should be performed. I have read with interest a pamphlet issued by Price, Waterhouse and Co entitled 'The Auditor Encounters Electronic Data Processing'. There are many other thoughtful essays on the same subject. From their tenor I would judge that in the professional auditors' opinion, external audit can be appropriately adjusted to the new conditions.

Apart from the management consultant portion of accounting firms, far too few of the professional accountants have yet become sufficiently immersed in the new EDP developments. This is a pity because, through the experience they gain as they move from one firm to another with different approaches, they could play an important role in helping clients include the safeguards which undoubtedly are required before the new systems can be accepted as satisfactory.

Impact on the general business intelligence function

The fourth function is general business intelligence. This is the one to which I wish to give prime emphasis in this paper. Much of this business intelligence must originate in the Accounting Department. It is here that EDP can have its most profound impact by providing better management information than would otherwise be possible. Better information must be followed by a rapid change in the organisation and methods of management control. This will in time change the fundamental character of management itself.

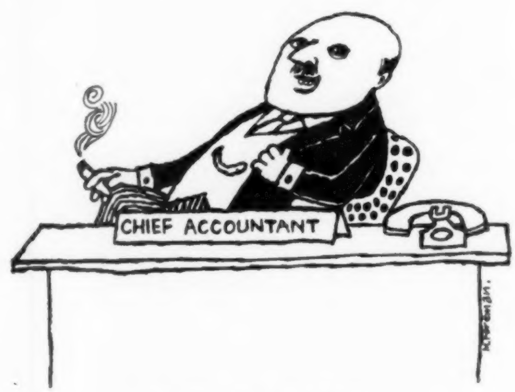
Better management information stems from the ability of the integrated system to fulfil five essential requirements:

1. To provide pertinent basic information in a useful form to each department at various levels of operation, and meet the ever growing demands for statistical and corporate information required by government and regulatory authorities.
2. To provide storage for new and old information on the widest possible range of company activities.
3. To provide thoroughly reliable information.
4. To provide the information at the earliest useful time.
5. To provide selected information which will require a minimum of further human manipulation to achieve maximum objectives.

I have already illustrated the first of these, providing basic information in a useful form, by reference to our method of handling waybill information and the distribution of output.

The second, storage of information, is achieved through the use of magnetic tape which provides a large reservoir of recapturable information upon which to draw. At present we can store on one reel of tape the equivalent of four books, each the size of the Bible. Such a reel can be read into our computer in a matter of four minutes.

The third requirement is the ability to provide thoroughly reliable information. When data was being assembled manually, piece by piece, errors occurred which in many cases passed detection. With integration, if, for instance, proper sequential reports are not received on a freight car, this shows up immediately. While the dangers of error through the capacity of the computer to multiply errors are greater, there is more opportunity to build in safeguards as the data from one source or one report are compared with those from another. As these techniques are refined, our experience shows that the reliability of data will far exceed anything heretofore available.



I account, therefore I boss.

Continued on page 41

AMERICAN REPORT

from John Diebold and Associates, New York

Will We Talk to Computers?

In future ADP systems computer input techniques may be radically different if some of the research work now being done pays off.

'The greatest unfulfilled need in the field of automatic data processing is the development and use of advanced ideas in computer organisation. While the development of high-speed circuitry remains important, much can be gained through careful analysis of the computer system as a whole.'

THESE prophetic words were uttered a little more than a year ago by Dr W R Bauer, Head of Ramo Wooldridge's information system department, when he was asked to comment on the problems which will be facing ADP system builders and users in the years ahead.

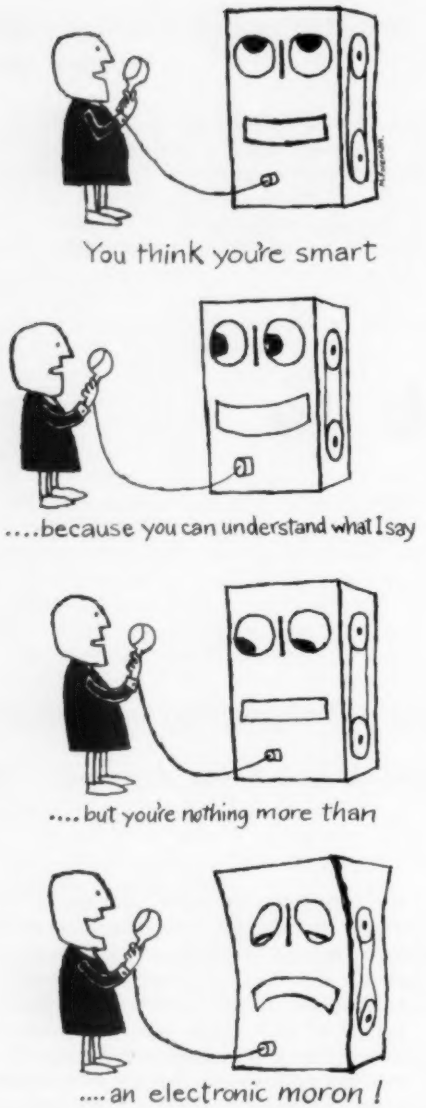
Although relatively little is heard about them, several major computer manufacturers are now conducting extensive studies and pilot projects which may bring about some startling changes in computer organisation. There are two compelling reasons why you do not read or hear much about this work: first, most of it is still in the 'experimental stage' and from the scientists' point of view, the less said about it the better; and secondly, practically all of these projects are of a proprietary nature.

It is not surprising, therefore, that the few research reports that do filter out of the laboratories are usually sponsored by public, not private, funds.

Possibly the two most interesting and potentially significant computer reorganisation ideas that anyone is willing to talk about now are computer input systems that will recognise and respond to oral instructions and systems that are able to learn and improve performance solely on the basis of exposures to external stimuli.

Practically every researcher who has ever been exposed to some aspect of the problem of using speech as a computer input agrees on one point: the obstacles standing in the way of a practical system are formidable. However, there is some basis for a measure of cautious optimism in the light of developments during the past 36 months:

> A recent report from the Massachusetts Institute of Technology indicates that a computer output system has been developed there that will accurately reproduce spoken commands by different voices (male and female) 98 percent of the time.



Bell Telephone Laboratories have successfully tested a 10-word recognition device that could be used for voice dialing of telephone numbers.

A ' phonetic typewriter ' (types in response to a voice-dictated input) first built by the Radio Corporation of America in 1956 has undergone a number of refinements in RCA's own laboratories as well as in the Electronics Department of Japan's Kyoto University.

An input system that is capable of recognising words must perform several basic functions. For example, a speech signal introduced to the system outlined in the diagram on page 25 could be transformed by normalisation[1] and frequency spectrum analysis. Phonemes[2] are the distinctive elements of speech.

Consequently one system approach would be to recognise individual sounds as a step in speech translation. Phoneme recognition can be based upon such properties as the frequency spectrum and amplitude characteristic as a function of time. Phonemes that are recognised can then be decoded into words and a decision made to accept or reject the translation.

According to James C Bliss of Stanford Research Institute, several difficulties have been encountered in pattern recognition of speech decoding. He points out that although many speech sounds give rise to a pattern that is basically distinctive, there are considerable variations in these patterns due to differences in voice quality, pronunciation, intonation of speakers and in the context of sounds.

The basis of a speech translator which is essentially an automatic digit recogniser (built by Bell Telephone Laboratories engineers) is the structure of formants.[3] Formant frequencies serve as important criteria in human recognition of steady-state vowels. Bell's automatic digit recogniser (dubbed AUDREY by its designers) recognises speech by an analysis of a two-dimensional plot of the dominant formants. A pattern-matching network then compares the distribution of the unknown signal with each of several stored reference distributions to determine which pattern is most like the unknown.

Bell has also developed a phonetic pattern recogniser which is based on two principles: recognition of sustainable patterns of power-versus-frequency in speech; and recognition of durations of such phonetic patterns in words.

Another type of mechanical speech recognition device has been developed by J Dreyfus-Graf of Geneva. His design is based upon the idea that speech information is correlated with the pattern of rates of change of energy in separate bands of the acoustic spectrum.

Work carried out at the Massachusetts Institute of Technology on the intelligibility of amplitude-limited speech waves provided the theoretical basis for an entirely different approach. MIT researchers found that under certain conditions extremely severe amplitude limiting does not impair intelligibility. This is true even when the speech wave is modified so drastically that the only connection with the original signal is the sending of a

[1] Normalisation is the process of transforming voice signals to a common basis; for example, the adjustment of two signals (representing the same spoken word but differing in loudness) to the same amplitude.

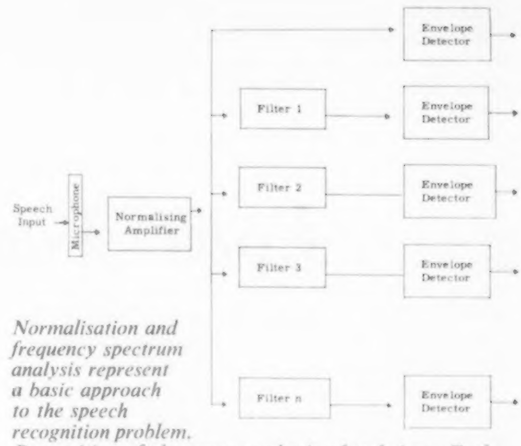
[2] Phonemes are the minimal set of the shortest segments of speech which if substituted one for the other, convert one word to another. In an analogy between speech and written text, phonemes correspond to the letters of the alphabet and are the individual sounds from which each is put together.

[3] Formants are the particular frequency regions in which the energy of a vowel sound is most strongly concentrated.

pulse each time the wave crosses the zero axis.

In some of the other systems which are now being developed, recognition is accomplished by comparing transformed speech data with data in a computer memory. The major drawback of this method is that a massive amount of data must be stored in the computer memory section if all speech variations are to be accommodated.

One way in which versatility could be provided in a voice input system, is to use a memory in which the operator can store representative speech patterns of his voice. These could be recorded in the computer memory and subsequently used as standards for comparison in decoding. Possible storage medium for such an application could be an array of square loop magnetic cores.



Normalisation and frequency spectrum analysis represent a basic approach to the speech recognition problem. Recognition of phonemes are basis of technique. Each filter is designed to pass one specific type of phoneme. Phoneme recognition itself can be provided by such properties as the frequency spectrum and amplitude characteristics as a function of time.

ALTERNATIVE TO SPEECH INPUT

An interesting project that appears to have some promise has been undertaken at the Harvard Computation Laboratory under a grant from the National Science Foundation. Gerard Salton, an instructor in applied mathematics there, has been working on the prototype of a system that could conceivably accept a transcribed form of machine shorthand.

Salton reasons that many of the difficulties arising in the transcription process are similar to problems encountered in automatic translation of languages and in analysis of speech. The problems involved in digitalising speech for input to a computer have prompted him to work on method for using machine shorthand notes as the input medium. Because stenographers are trained to record spoken information at high speed, Salton believes that it may be possible to solve a substantial part of the problem of feeding oral signals into a computer by using transcripts as machine input.

Machine shorthand furnishes notes on paper tape which may serve as direct input to a computer handling the translation process. Salton has been designing his systems around the outputs of Stenotype and Stenographic machines.*

USING EXTERNAL STIMULI

A pattern-recognition capability, coupled with an innate ability to learn and consistently improve its performance, are the two most significant characteristics of the Mark I Perceptron. The Mark I is the first of a series of machines that Cornell Aeronautical Laboratory (CAL) expects to build (under sponsorship of the US Navy's Office of Naval Research) during the next few years. It was unveiled last summer, slightly less than two years after CAL's Dr Frank Rosenblatt formulated a plan for a machine that could be trained to automatically identify objects or unusual patterns.

The Mark I does not recognise forms by matching them against an inventory of stored images or by performing a mathematical analysis of characteristics. Briefly, these are its principal operating features: a bank of photocells are activated by a drawing or simple pattern (focused on the photocell array by a camera lens). Those photocells that are activated by some segment of the pattern or drawing transmit electrical signals to a set of association units (A-units). If the input signal to an A-unit is large enough, the unit becomes active and emits an output signal. The active A-units, in turn, transmit signals to response units. Response units are two-state devices which emit one output if their input is positive and a different output if their input is negative. The output of an A-unit (a positive or a negative voltage) is controlled by a value storing device in the A-unit. The settings of these devices (which are constantly modified as a result of repeated exposures of the photocell bank to the same design or drawing) represents the memory of the Perceptron.

At least three other organisations (the Aeronutronic Division of Ford Motor Company, General Electric Company, Bell Telephone Laboratories) are actively engaged in the development of pattern recognition devices which may eventually be utilised for the design of radically different kinds of computer input systems.

The present level of the technology is prompting many of the scientists working on these projects to predict eventually development of input devices that will detect and respond to such external stimuli as colour, unusual shapes and patterns as well as the human voice or other aural signals.

* Keyboard devices for representing consonants and vowels heard by the stenographer.

Four Years Later

—it's taken for granted

The City of Norwich, which first installed a computer in 1957 no longer considers spending money on computers as a revolutionary or particularly 'progressive' move, but merely a straightforward way to improve efficiency.

HOW does one measure the success of an established EDP installation? Manpower savings seldom tell the whole story—especially when a diplomatic smokescreen envelopes anything which seems to go beyond the reductions caused by normal staff wastage. A comparison of 'before' and 'after' processing times can be equally confusing, because the introduction of EDP is generally accompanied by far-reaching changes in procedure. Above all, it is difficult to place a firm value on such benefits as greater speed and accuracy, or the production of management information in more useful forms.

There is, however, one perceptible sign of success. It is the point of 'acceptability'—when a computer ceases to be an innovation or something extraordinary and is simply regarded as an efficient piece of office machinery.

This has happened at City Hall, Norwich, where a large proportion of the clerical work is now done on a National-Elliott 405 installed over four years ago.

The Norwich 405 has had its hour of fame. In February 1957 it achieved the distinction of becoming Britain's first magnetic file computer—at a time when no computers of any kind were handling routine office work outside their manufacturers' own premises. But the 'pioneering' side of this project is now almost forgotten. Over the years the machine has steadily absorbed more and more of the work of the City Treasurer's Department. Some of the new applications have taken longer to develop than was originally planned; others—to quote the City Treasurer—have 'gone like a bomb'. All of them have been successful in the sense that the work is now being done more quickly and efficiently than before.

The point of 'acceptability' was reached some time ago. In April this year the Council decided to part-exchange the original machine for a larger 405 system. They did not take the view that they were being asked to spend money on a 'progressive' and possibly useful experiment. On the contrary, they treated the proposal as they would have treated any other request to install more efficient equipment.

NO NONSENSE

The Norwich computer has established itself by doing straightforward clerical jobs in a straightforward manner. There have been few opportunities for spectacular achievements in the field of management control.

There are also restrictions on the use of automatic exception-reporting. In theory the rate book—now stored on reels of magnetic film—has only to be printed out at the end of each half-yearly rate accounting period. In practice, this method of working would produce considerable difficulties. Every day the City Treasurer's Department is asked about the rates position of properties which are changing hands. Therefore the financial benefits of a theoretically perfect computer system would soon

be offset by dealing with *ad hoc* enquiries.

There are similar restrictions on such operations as the costing and expenditure (although in developing the computer systems the Council has managed to achieve a considerable degree of integration and automatic decision-making).

These limitations were recognised at the planning stage. In an early report to the Finance Committee, Mr A J Barnard, the City Treasurer, defined his requirements as:

> 'A system which records data and the movement of data. . . . It must be capable of storing data in a small space; and of allowing periodic access for either reference or processing. It must also be capable of producing bills and pay documents and of analysing these for costing and budgetary purposes.'

The search for new working methods had begun in 1949. A punched card installation, previously used by the City Engineer, was transferred to the City Treasurer's Department and various jobs, including invoice analysis and debtor control, were put on to it.

However, the installation was too small to handle any of the major book-keeping tasks and for some time these continued to be done manually. The Council then decided that more advanced methods were needed to deal with steady increases in the volume of work. Although their administrative costs were not exceptionally high, they believed that these could be reduced considerably by installing some form of mechanisation.

Eventually it was decided that the introduction of a larger punched card installation—or even a punched card computer—could be too timid a step at that stage; only magnetic filing would meet the Council's present and future needs in an economical way. Today it seems a logical decision. At that time it was also a bold decision—there was no operational experience to draw on in Britain, and reports on American magnetic tape systems were too fragmentary to be wholly reassuring.

However, Elliott Brothers had recently developed a magnetic filing system which employed sprocket-driven 35-mm film as the storage medium, and when this company made a working agreement with the National Cash Register Co, the City Treasurer finally decided to go ahead with his plans.

When it comes to playing the pioneer, a municipal authority handling public money, has to exercise considerable caution. For this reason the Norwich 405 system is a small one—smaller, in fact, than any of the 405's installed subsequently by government departments, public utilities and commercial organisations. In its present form it consists of a central processor, two magnetic film units, paper tape reader, and paper tape punch. Documents are printed off-line by a battery of four character-printers.

Using this equipment, the City Treasurer's Department has been able to 'computerise' practically all of its clerical work. At present, productive time is never less than 31 hours per week and rises to 57 hours per week in the two months of the year when rate demand notes are issued. Down-time caused by machine faults or unscheduled maintenance work is negligible.

RATE ACCOUNTING

Of the main applications carried out on the department's machine, rate accounting is probably the prime. This operation includes both general rate and water rate accounting. During the twice-yearly cycle, the computer produces demand notes, final demand notes and a cost summons list; regularly posts payments to the appropriate accounts; and amends static data whenever properties change hands or are re-rated. A rate charge book is obtained by collating copies of the demand notes, and a rate book is printed out at the end of each accounting period.

In Norwich there are about 25,000 individual rate-payers, 47,000 rated properties and 47,000 water-consumers. These figures reveal the dimensions of the operation.

For every rated property, the following basic data is stored on magnetic film:

Reference number:
Address
Ratepayer's name
Reference number of owner if rates are not paid by the person occupying the property.
Net annual value.
Rateable value.
Type of water charge.
Description of property.

At the start of the cycle, the current rate in the pound is read into the computer by means of a short length of punched paper tape. The computer then goes through the magnetic files and calculates the total rates due on each property. This information is automatically added to the basic records. At the same time, the computer punches into paper tape the details which will subsequently appear on the demand notes. The present rate of computer processing is between 700 and 800 notes per hour. The notes themselves are produced in duplicate on continuous stationery at the rate of 15 characters per second. After the continuous forms have been separated, the originals are despatched to the ratepayers and the carbon copies are bound into the rate charge book, which thus shows the total rateable value of all properties under the Council's jurisdiction.

For each payment of rates—whether made by post or over the counter—a receipt is produced on a National receipting machine. The receipt incorporates a detachable stub, which becomes the posting voucher. Simultaneously a record of the

payment is printed on an audit strip locked inside the receipting machine and totalled at the end of the day to provide a control figure.

The day's batch of stubs is passed to the computer section, where the information on them is punched into paper tape and verified. At fortnightly intervals these tapes are fed into the computer, which sorts the information into property order and posts it to the appropriate accounts. Employing the now-familiar ' father and son ' technique, all the basic data are re-written, with the corresponding payments data, on to a new set of magnetic films. Thus the original records are kept intact as a precaution against loss or damage.

Amendments to the basic data are made in much the same way. Details of each amendment are written on a specially-designed slip, on which punching and controls are pre-printed as an aid to the punch operators. These slips are hand-sorted into property order before the information is punched into tape.

After the prescribed period has elapsed, the computer goes through the current set of magnetic films and picks out every property on which the rates are still owing. This operation results in a paper tape from which final demand notes are printed in the same way as the original demand notes. In due course, a similar operation produces the court summons list.

During the fortnightly runs, the computer produces printed lists of all amendments and postings, together with accounting summaries. The complete contents of the magnetic files is not printed out until the end of the accounting period.

BILLS AND CLAIMS

On rate collecting and accounting the computer is primarily used as a clerical ' workhorse '. But the bills and claims application has given the City Treasurer's Department an opportunity to develop more sophisticated processing techniques.

This application is divided into two parts: first, the payment of accounts, including the preparation of remittance advice notes and cheques and, second, the regular analysis of payments for the purpose of budgetary control.

Once again, the volume of work is considerable. The Council have over 6,000 creditors, and invoices are received at the rate of at least 10,000 per year.

For the payments routine, invoice data is punched into paper tape. Each batch of invoices is totalled on an adding/listing machine and this figure, too, is punched into the tape to act as a control during the computing operation.

As each invoice arrives, it is rubber-stamped with a ' box ' which enables supplementary data to be recorded in a systematic manner (without necessitating a supplementary document), and thus simplify the thrice-weekly punching operation. The department responsible for the expenditure fills in the ' punching authority ' details, and the City Treasurer's Department adds the appropriate accounting instructions.

At fortnightly intervals the invoice tapes are put through the computer, which produces the output tapes from which remittance advice notes and cheques (one for each creditor, irrespective of the number of invoices he has submitted during the previous fortnight) are prepared on the battery of character-printers. Simultaneously, details of all payments are recorded on the magnetic films dealing with current expenditure.

These films are subsequently used in the analysis routine, during which the outgoing payment is posted to 4,000 budget heads.

The nominal ledger—consisting of the expenditure budgeted under each of these heads—is also maintained on magnetic film. In a separate computing operation, the current expenditure is compared with this to ascertain what variances have occurred.

Each expenditure is allocated to the appropriate authorising committee (of which there are nearly 100) and a total is produced for each committee. The committee themselves are grouped in ' Funds ' and here, too, separate totals are provided automatically.

In every case where the cumulative expenditure exceeds the budget figure for the corresponding part of the accounting period, the computer automatically punches out a special symbol. This greatly simplifies the task of budgetary control—aided by the fact that the analysis records are always up-to-date.

Everything paid out by the Council is now put through the analysis routine. A separate expenditure film provides information of standing payments to creditors. Information of wages and salary payments is summarised and merged with the main expenditure records at quarterly intervals.

PAYMENTS OF DEBTORS

There is an equivalent routine covering all income due to the Council. This, too, is divided into parts, one concerned with standing debtors and the other with sundry debtors. In both cases the basic and cumulative information is stored on magnetic film.

The first group covers such items as council house rents and charges for allotments, and involves about 3,500 debtors. The second group covers all other goods and services provided by the Council.

Billing is done weekly, primarily because it was originally intended to bring ' home helps ' into the system (although changes in the ' home help ' service have now eliminated the need for this). The posting of payments received is done on the same

lines as the corresponding part of the rate accounting procedure.

MORTGAGE RECORDS

This relatively simple twice-yearly task involves the maintenance of records for about 3,000 mortgages held by the Council.

There are two distinct operations: first, the preparation of interest warrants and tax deduction certificates for the individual mortgagees; and, second, the calculation of maturity schedules to control the Council's loan transactions.

SERVICE WORK

During the early stages of the project, when the rate collecting and accounting procedure was being set up, the Council decided that they could increase the profitability of their computer installation by doing service work for other organisations. Subsequent developments in the Council's own work have made it increasingly difficult to pursue this policy, but enough has been done to confirm that it has definite possibilities.

One long-standing service job is the weekly processing of share price data for the Council's stockbrokers. The data arrived by the London train on Friday evening, and the tabulated results are despatched early on Saturday.

Other jobs were done for a local firm of constructional engineers who have now installed their own computer.

Although the Council's service charges were unusually low—£15 per hour—these operations produced some useful income, during the first two years of the project. Indeed, the service payments received during that period amounted to about 10 percent of the capital cost of the computing system. It is possible, therefore, that this side of the project will be resumed and developed still further when the new computer is installed.

TIME FOR EXPANSION

As experience was gained, the City Treasurer's Department progressively improved its programs and working methods. This is reflected in the way that the processing times for different jobs have become shorter and shorter. For example, the first rate demand note operation took nearly 200 hours, even though the water charges were handled separately at that stage. In subsequent half-years this was reduced to 127, 122 and 70 hours. Now it is done in 42 hours.

Nevertheless, it became apparent this year that the capacity of the installation would have to be enlarged if it were to deal efficiently with forthcoming demands on it.

One reason was the continued growth of the work of the City Treasurer's Department. An investigation revealed that since the beginning of computer project, the annual increase had been in the region of six or seven percent.

Another reason was that the computer section was preparing to take over the costing work previously handled by the punched card installation inherited from the City Engineer's Department. This commitment—together with other proposals—seemed likely to raise the danger of overloading the computer, especially at the peak periods when rate demand notes were produced.

Theoretically, there would be no difficulty in extending the original system. But the obvious disadvantages of adopting this course was that the inevitable period of down-time while the changes were being made, would interfere quite seriously with the Department's routine book-keeping. For this reason the Council decided that it would be much better to take a new machine which could set up alongside the original machine. Because of the interchangeability of programs, the work could then be switched from one machine to the other overnight.

The new system, due for installation in a few weeks' time, is considerably larger than its predecessor. It has three magnetic film mechanisms instead of two, and four times the internal storage capacity (16,384 words, compared with 4,096 words previously). Even more important is the improvement in output facilities. The new machine will have two Teletype punches, each operating at 100 characters per second, whereas the total output of the present machine is only 85 characters per second.

FUTURE DEVELOPMENTS

In due course the established programs will be re-written to take full advantage of the increased performance of the new computer. This, in itself, will lead to further reductions in processing times and will provide spare capacity for other applications.

The costing application is now at an advanced stage of preparation. When it is fully developed, the production of cost data will be integrated with payroll and salary accounting and maintenance of the stores ledger.

The work will be put on to the new computer in two stages. During the first stage, labour cost data will be punched in tape from the employees' timesheets. When the second stage is reached, it will be obtained automatically as a by-product of the computerised payroll accounting procedure, during which the machine will produce individual payslips and other related records. Material cost data will be extracted in much the same way from the stores ledger procedure.

Present saving in staff amounts to 20 employees, but this figure is expected to rise to 44 when the project is complete. Additional savings will come from the elimination of the punched card equipment on which cost records are now produced.

JOB MARKET REPORT

Trainees in demand

Wherefore systems analysts

The Establishment bid

WITH the university year ending last month, companies were graduate hunting—and to prove it were many advertisements for programmers, operational research men, and even O and M personnel, where the premium was on qualifications other than experience in the computer field. Of the 14 advertisements for programmers, six were from companies prepared to take graduates or mathematics students and train them. In other cases, experience with computers was desired rather than required. In the operational research field, where there were eight vacancies—an all-time high—four were available to untrained mathematics graduates in suitable cases, and even in the case of an OR team leader, experience was 'desirable but not essential'.

Is it possible, one wonders, that the bottom of the barrel has been scraped, as far as experienced men are concerned, and that computer users, as distinct from manufacturers with built-in training facilities, are finding it more advisable to expand their existing nucleus of trained staff, by do-it-yourself training methods. The trained man is still in demand, and there are signs that his market price is being stepped up a peg or two. Hence the need for new (and cheaper) blood.

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Programmers are in demand, due to a number of computer users expanding their staffs (and installations) and a number of manufacturers' service centres being set up. Remington Rand, offering Univac systems in this country for the first time, require a whole gang of programmers; a programming manager with four years experience in the computer field, senior programmers with two years experience to head up programming teams, and junior programmers with practical programming and computing experience. These are to evaluate proposals for Univac III and 80 installations, and work on the Univac 80 in London and Manchester. No salary details are given. By contrast CEIR, the computer service organisation, who require programmers with experience in 'costing' computer programs, give the salary range for their programmers as £1,200–£1,600; nor need these programmers be fully fledged, since they will have to undergo training on CEIR's proprietary program systems and on CEIR's hired IBM 7090 and 1401.

Elliott Brothers, who have established a special computer division to study on-line computer working for airline seat reservation and traffic control, require senior and junior programmers with experience and graduate status. In addition NCR Electronics want analyst-programmers and computer operator-programmers for their City 'laundrette'. These people, who can be 'A' level school leavers, graduates, or people with commercial and 'city' backgrounds, will be trained from scratch on computers. Other people, but with experience, are also needed.

Of the expanding computer users, Fords, introducing a new production and material control system, need additional staff—programmers under 30, operators aged 20–24. They too are prepared to train graduates or similarly qualified men or women who have no previous computer experience. Training is also offered by Vickers Armstrong to junior programmers (aged 19–23, with 'O' level mathematics, logical minds and the ability to work out simple algebraic problems). Vickers also require senior programmers.

Experimental departments in the computer field, both at manufacturer and user level, are also staking their claims to the marketable floating population: Joseph Lucas want a graduate mathematician with knowledge of SOAP and Ferranti autocodes, for scientific and statistical work; Rolls Royce also require experienced programmers for research and development projects; and finally, BEA, building up a team to study on-line computing for seat reservation require a chief programmer (with practical experience of directing teamwork, time sharing routines—salary up to £1,817) and programmers with good mathematical ability and practical knowledge of programming (salaries up to £1,417).

A demand for a hybrid type of personnel is now discernible: people who can combine the organisation and methods function with programming skills. These people are generally referred to as 'systems analysts'. Unfortunately, the label of 'systems analyst' is also being used by the computer manufacturers to describe their own sales staff—the blue-eyed boys who draw up the initial computer scheme, and sit in with the customer until his system is operating. There were some six vacancies for these kind during the last month; with IBM (under 35, successful experience in industry, ably to apply knowledge to solution of accounting, recording and computing problems, salary up to £2,000); for NCR Electronics (aged 30–40, able to plan and instal mechanised systems, salary £1,200–£1,500); De la Rue Bull (27–35, secretarial—accounting experience, able to negotiate at top level) for Remington Rand; and for EMI (aged 25–35, for investigation work, defining requirements of potential customers and proposing computer applications). In this category of systems analyst, comes also an advertisement by Personnel Administration of New South Wales (for a man, aged 28–34 experienced in system analysis, programming and operation of computers).

However, in five other advertisements, the requirement for systems analysts came from computer and punched card users. In these firms, the systems analyst was to be an organisation and methods man who would be definitely assigned to computer development. This point is stressed by Co-operative Insurance Society, who advertised for O and M men, whose work would be complementary to the computer development department. In the case of Rubery Owen and Co, the systems analyst will also program the systems which he has planned. Rubery Owen are prepared to train suitable applicants from scratch. BICC, the cable manufacturers, also required analysts, for systems development (experience of commercial methods essential, punched card systems desirable); so did Carreras. In Carreras' case the vacancies appeared to be for an O and M man under another name, because his duties involve clerical investigation, reports on adjustments to procedures, and compiling standing constructions and work flow charts. Systems analysts and senior analysts were also required by Rolls Royce, and the Steel Company of Wales. The systems analyst seems to enjoy a higher status than the O and M man, and his salary is in the upper bracket of the O and M scale, £1,650–£2,000 being the average salary range.

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The O and M field is still expanding. Over and above the systems analysts quoted, there were 30 vacancies advertised in the period under review. Establishment organisations like the BBC, NAAFI, and Granada TV were in the market for the first time, as were food manufacturers Sainsbury's and Rowntrees, and two local government bodies. Tyres, rail and air transport, and petroleum were represented by Michelin, Aer Lingus, British Railways (Eastern Region) and Petrofina, while the usual manufacturing and industrial 'heavies', Richard Thomas and Baldwins, and Lockheed Hydraulic Brake Co and Guest Keen and Nettlefolds were supplemented by GEC, Reed Paper Works, and Turner and Newall, and Kodak. Two consultant firms, one of them CEIR, required O and M executives; CEIR's salary range—£2,400–£2,800 for a senior executive (accountant preferred) and £1,600–£2,000 for an assistant executive (accountancy qualification desirable)—was somewhat higher than the established norm. For an O and M officer in the local government and hospital fields £1,000–£1,500 was usual; Co-op Insurance offered its assistants up to £1,235. However, there seems a tendency towards high salaries; Sainsbury's offered not less than £1,750, and the BBC £1,575, rising by increments to £2,000.

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Operational Research continues to be the prerogative of the giants, though computer manufacturers and consultants are establishing their own divisions. English Electric require qualified engineers and scientists to work on various industrial computer studies, the application of computers to process control, production planning and information handling; they will accept Honours men in engineering, physics, and mathematics, and provide training where required. The emphasis of this work is on the steel industry's problems, and indeed BISRA and the steel companies have been the earliest pioneers in this work, and are still recruiting, one of the OR vacancies this month—as in most months—being for an OR team leader for the steelworks of Guest Keen and Nettlefolds. Fords, the British Transport Commission, the Admiralty, and United Kingdom Atomic Energy Establishment are also in the market for OR men, as well as the Heavy Organic Chemicals Division of ICI. Honeywell Controls Ltd, coming into the computer field with the 800 and 400 computers, want an operational research specialist (no qualifications specified) and Associated Industrial Consultants are concerned with training suitable graduates for operational research consultancy.

More details of OR salaries are coming to light: trainee OR men with British Transport receive £780–£1,290; research group leaders are offered up to £2,250, and an assistant director of research £2,250 plus. The Admiralty offer principal scientific officers in OR £1,716–£2,418, though these figures may be higher since the minimum rate is under review. The upper age limit for OR men is given as 40, and a qualified man is expected to have two years experience in OR work.

Four Computers Compared

They are all medium-sized, designed for business applications and have yet to be installed in Britain. How do they compare?

R Murray Paine

At the present time there are a great many digital computers available in Britain—in fact, never was the choice more abundant—yet these machines vary in power and price, and while we can herd machines into pens labelled 'large', 'medium-size' and 'small' for easy classification, this does not always help the executive genuinely interested in comparing like with like, and facility against facility, before deciding what is the best computer in the market *for him.*

While obviously a report on computers cannot emulate the magazine *Which?*, where reports on consumer goods indicate, on the basis of tests carried out, what are the 'best buys', a comparison of a handful of computers designed for the same market and carrying approximately similar price tags can be of value to management.

This article is in fact concerned with four new, medium-sized, transistorised computers, designed for business applications, none of which have yet been installed in Britain. The machines are the Honeywell 400, the ICT 1301, the IBM 1410 and the NCR 315, and all are in the price range of £100,000 to £200,000.

Computer comparisons are always difficult to make (and delicate to publish!) since there are no constants and even one machine system has possible variants—it is like playing croquet with a twisting flamingo as a mallet. However, an idea of the size of these systems can be gauged if similar 'basic' installations are first described.

The Honeywell 400 starts as a central processor, with 1,024 words of core store; four fast magnetic tape units, a 650 cards per minute (cpm) card reader, and a 900 lines per minute (lpm) printer—selling for around £140,000. The 1301, in a comparative specification, has a central processor (1,200 words of core store, and 12,000 words on drum), four 'standard' magnetic tape units, a 600 cpm card reader, a 100 cpm punch and 600 lpm printer—selling for about £138,000. The IBM 1410 (larger than the 1401 system) with central processor (10,000 alphanumeric characters of core store); four Type 7330 magnetic tape units, a 800 cpm card reader, a 250 cpm punch and a 600 lpm printer, is on the market for about £170,000. The NCR 315 is priced at approximately £100,000 for a system consisting of central processor (20,000 numeric characters of core store) 1,000 characters per second (cps) paper tape reader, 120 cps tape punch, one random access unit of 5,500,000 characters and a 680 lpm printer. (Note no card or magnetic tape equipment in this configuration, though it can be provided.)

Just stating these facts shows how the flamingo struggles—nothing is constant. NCR are stressing that replaceable random access cartridges may mean that a 315 system need not require magnetic tape units for filing information. However, a 315 system with four magnetic tape units (and no random access units), would probably amount to about £160,000.

Simultaneous Operations

It can be seen that all four machines have fast input and output equipment which is a great advantage for commercial work and contrasts with peripheral devices for earlier machines. But more important than the speeds of the individual units is how many input output operations and what internal processing can be performed at the same time. None of these machines are really equipped for the parallel processing of different programs.

The basic Honeywell 400 has no buffers, and when data are being actually transferred between one peripheral unit and the core store, no other internal or input-output operation can be performed. However, some of the cycle time is not used for the transfer of data and is available for internal processing. The times available are 40 out of 92 milliseconds on the card reader, 63 out of 240 milliseconds on the standard card punch and 14 out of 67 on the printer. This means one cannot read cards and print at the same time. An optional feature available is the 'print buffer', which would be worthwhile fitting since it permits printing simultaneously with other operations. The 400 can read from one tape while writing on another, but during

tape operations no internal processing or card operations are possible and printing is possible only if a ' print buffer ' is fitted.

The ICT 1301 does not use buffers either; however, it does not transfer data from peripheral units in continuous blocks, but in very short bursts under program control (*eg.* six columns on the reader and one character on the printer). It is thus able to keep card reader, punch and printer operating simultaneously, by jumping from one unit to the next. Magnetic tape could be operated at the same time if necessary, but it is more likely to be run separately. The 1301 can read from one tape, write on another and perform internal processing at the same time. These features of the 1301 make it a powerful computer, but they do require detailed programming (supplied by the standard subroutines) and a fair amount of program and storage space.

On the NCR 315 system the printer and the card punch have buffers and therefore can operate at the same time as other units. While the paper tape is being read the short time between characters would be used for decoding but not for other work and the printer could be operating at the same time. There are three milliseconds between punching characters on the tape punch which could be used for internal work and there are some 20 milliseconds out of 152 milliseconds on the 400 cpm card reader cycle during which processing could continue. Processing could continue during the 200 milliseconds search operations on the random access units, and only the transfer time to core store is lost to processing or input-output (except for the printer or card punch). The machine allows reading from magnetic tape or writing on tape, but not both together and only buffered or search operations can continue in tape time.

The IBM 1410 has buffers for the card reader, punch and printer which enable it to perform these operations and process at the same time. Data are transferred to and from the buffers and core store via a data channel. It is possible to perform buffer-to-buffer transfers without using the central computer, and thus do off-line work. Although only one input-output buffer can use the channel at a time, the other buffers can be topped up or drained while this is happening. For the card reader the channel transfer takes 11 microseconds per character or only just over one percent of its cycle time, and in this time internal operations are impossible. However, if ' processing overlap ' is fitted, half of this transfer time is also available for internal work. Magnetic tape data go direct into the core store, not via a buffer, and for the IBM 7330 tape unit the transfer time is 50 microseconds per character—but ' processing overlap ' will free all but six microseconds for internal work. However, if it is required to read and write tapes and perform processing at the same time, a second data channel, a second tape synchroniser and ' processing overlap ' must be added to the above specification at a cost of about £15,000. These additions would give easier and more extensive simultaneous operations than the other three computers but at a significantly higher price.

Data Representation

Of the four machines under review two have a fixed word length, one a variable word length and one can be considered as being ' in between '. The 400 has a word length of 48 data bits plus two parity bits and represents decimal digits by four bits and alpha characters by six bits. The 1301 has the same word length but represents decimal digits by four bits and alpha characters by eight bits. The 1410 has no fixed word length but each position of storage is addressable. An 8-bit code is used for both decimal and alpha characters, and consists of six data, one parity and one word mark bit. The 315 has a structure of ' short ' words—elegantly called ' slabs '—of 12 data and one parity bit. A slab can hold two alpha characters or three decimal digits, and up to eight slabs can be linked together to cater for variable length working. Thus it can be seen how difficult it is to compare the storage capacities of these machines especially as it is generally agreed that variable word-length machines use their storage better than fixed-word machines. On a *direct* conversion of the above specifications to decimal digits it would appear that the basic 400 system has space for 12,288 digits, the 1301 space for 14,400, the 1410 space for 10,000 and the 315 space for 20,000. The 1301 has built-in sterling operations and this is promised for the 1410.

Internal Operations

The internal speeds of these machines are of the same order. It is difficult to compare one, two and three address machines, but a simple indication is the time to add the eight digit contents of two locations and place the result in one of the original locations ($A + B \rightarrow B$), including the extraction of operands and the instruction. This time in microseconds for the four machines is as follows: Honeywell 400: 120, ICT 1301: 58, IBM 1410: 144, NCR 315: 54. All but the 1301 have index-registers and on long loops of program this facility saves time and space.

The approximate multiplication time for six digits by six digits is, in microseconds: Honeywell 400: 1,900; ICT 1301: 1,000; IBM 1410: 1,460; NCR 315: 610.

All but the 1301 have special edit instructions that suppress non-significant zeros, float £ signs, etc, which are extremely useful for printing commercial work. The 1301 performs this work by subroutines.

Extra Equipment

All the systems can be expanded

from the specifications given above —and a plethora of facts can be listed. The 400 can have eight magnetic tape units, 4,096 words of core store, paper-tape reader and punch, card reader and punch, printer and random access store. Also printing off-line printer from magnetic tape is possible.

The 1301 can be expanded to eight tape units, 2,000 words of core store, eight drums, paper-tape reader and punch, card reader and punch, and printer. The 1410 can be stretched to 20 tape units, 40,000 characters of core store, paper-tape reader and punch, card reader and punch, more than one printer, magnetic character reader and random access storage.

The 315 is available with eight tape units, 80,000 characters of core store, paper tape reader and punch, one card reader (400 cpm or 2,000 cpm*) up to four card punches or printers, a magnetic character reader and random access storage.

Needless to say, additions add very substantially to the basic cost of a system.

Random and Serial Filing

There is a wide variety of additional equipment, but there is not space here to discuss more than random access storage and magnetic tape units. The 1301 can have a storage of 96,000 words or nearly one million decimal digits on drums, at a maximum access time of 12 milliseconds—much faster than the very large random memories. Three or four of these drums cost about the same as one IBM Ramac unit for the 1410 system. These Ramac units can hold either 10 or 20 million characters, and five units can be attached to one system giving a total storage capacity of 100 million characters. The access time ranges from 100 to 800 milliseconds, but this can be overlapped. IBM have announced a new memory (intriguingly called the IBM 1301) with a capacity of 50 million digits per unit; up to five units may be linked to a 1410. Since each disc has its own access arm the access time is reduced to a maximum of 180 milliseconds.

The 315 uses a different type of random access—flexible magnetic cards which when selected are wrapped round a drum where they can be read or written. There are 256 magnetic cards to a cartridge which has a capacity of five and a half million decimal characters and costs about the same as a Ramac unit; 16 cartridges can be fitted to give a total capacity of about 90 million characters. Access time is about 200 milliseconds which can be overlapped. The cartridges are removable so that one file can be removed and the next file fitted without the need to preserve the old file by writing onto tape or punching cards—and hence an installation may not need tapes or a card punch.

Honeywell have recently announced a random access storage unit for the 400. It is a disc form device with a capacity for 24 million alphanumeric characters per unit and up to four units (giving 96 million characters of store) can be attached to the computer. Maximum access time is only 170 milliseconds, which can be overlapped. The price is about one-third more than a Ramac unit, but further details are not yet available.

Magnetic Tape

Many models of tape units (which work at varying speeds) are offered as can be seen from the table below. These rates are the nominal speeds for reading bits of information on tape and when the individual stop-start times and the block sizes are taken into account the effective rates can easily be reduced by about 20 percent.

Programming

All four manufacturers supply the same automatic coding scheme —COBOL—a fair measure of its international acceptance. Symbolic methods of writing programs with a one-to-one correspondence and some macros* are also offered by three manufacturers—' EASY ' on the 400, ' Autocoder ' on the 1410 and the ' NEAT ' on the 315. Who is to say which machine will be easiest to program?

Summing up on these four computers, clearly one computer cannot be recommended above all others for all jobs. This could never be done in any comparison of computers: a computer is always acquired for one or several particular tasks, and although it may be the ' one best system ' in one case, it may not even be in the running in another case.

The four machines reviewed are certainly well suited generally for commercial work and are an advance on earlier machines. Putting the various features in juxtaposition, as I have done, does—speaking relatively—reveal strong and weak points in the systems, but then it should be remembered that what the engineer can devise, the customer may not always need.

* ' Macros ' for macro instructions; these are single instructions to call in sub-routines which control such operations as input, output and sorting.

TAPE READING AND WRITING SPEEDS
in characters of digits per second

Tape Unit	*Decimal Rate*	*Alpha Rate*
Honeywell	96,000	64,000
ICT Standard	22,500	11,250
ICT High-Speed	90,000	45,000
IBM 7330	20,000	20,000
IBM 729 II	41,667	41,667
IBM 729 IV	62,000	62,000
NCR (i)	36,000	24,000
NCR (ii)	60,000	40,000
NCR (iii)	90,000	60,000

* This card reader is the fastest available.

Punched Card Systems

THE tabulator (or accounting machine, as it is also called) is the processing unit of the punched card system; though each is individually designed to customer requirements, the basic structure comprises a reading unit (or units) for the cards, a line printer which enables the details from the cards to be printed out in the appropriate fields on discrete or continuous stationery, and accumulating and storage registers, which enable grand and sub-totals to be obtained. All these units, with subsidiary programming and selector devices, are controlled by a plugboard control panel. The tabulator extracts from the sorted cards the facts relevant to the desired results, feeds the figures into adding mechanisms (counters) and storage units, computes the amounts for which totals are required, subtracts or compares results at predetermined stages, and prints the details, totals, balances, and grand totals, in words and figures. In addition it incorporates programming facilities which enable it to direct an interconnected summary punch to punch out totals and other selected data into summary cards. On certain tabulators, notably the IBM 421, four classes of total can be punched into one summary card, and from one control operation up to five different summary cards can be punched.

There are eight punched card tabulators for 80-column cards currently available, the De la Rue Bull 534, and 535, the IBM 420, 421, and 444, and the ICT 900 series, 902, 906, and 915. ICT also have a 21-column card tabulator, and two 40-column machines, the 810, 816, and the 817.

The De la Rue Bull 534

Card reading speed: (from two reading stations) 150 cards per minute. The cards when read are fed into two reception pockets, thereby assisting in the sorting operation.

Line Printer: This consists of 92 or 102 independent character wheels, spaced equally along the whole length of the line—$14\frac{3}{4}$ inches—and set up by a selection board. Printing is done at a line a time, according to the form layout. The printing speed of the 534 is given as 150 lines per minute.

The calculating unit of the 534 consists of seven counters, each having a capacity of 14 digits (10 decimal positions for pounds, two for shillings and two for pence). The calculating program is determined by the plugboard, and addition, subtraction, multiplication and division can be carried out; in the case of multiplication the product can contain up to 15 digits.

The 534 also incorporates a selection unit, for selecting the fields for card reading and printing, and a program unit for automatically controlling the operation sequence.

The De la Rue Bull 535

This is an improved version of the 534, designed to connect up with a Gamma calculator. Its card reading speed, from two reading stations is the same, 150 cards per minute. Its calculating unit consists of up to 140 counting wheels for sterling or decimal working, which may be grouped and linked as required, allowing

The section on Punched Card Systems has been divided, for the sake of convenience, into three sections. The first part, which appeared in the July issue, dealt with manual and automatic key-punches and verifiers. The part in this issue covers tabulators and summary punches; and the September issue will cover reproducing and mark-sensing punches, interpreters and collators.

calculations to be made on amounts of any size.

Additional relay memories, an optional feature, allow a list of alphanumeric data carried on a single card to be printed in as many lines as required. Another feature is the split carriage, allowing two different documents to be printed at a single run, each part of the carriage having its own independent feed.

The IBM 420

Card reading speed: up to 150 cards per minute. (Data accumulated at 150 cards per minute, addition and subtraction carried out at 150 cards per minute.)

Line Printer: This consists of 88 type bars, 43 alphanumerical, and 45 numerical. Thus 88 positions are available for numeric data, while as many as 43 alphabetic printing positions can be recorded simultaneously. Printing speed is given as 80 lines per minute. Multiple line printing allows three lines of printing to be taken from each card, and four classes of totals can be printed out on one to four lines as required. Sterling totals or balances can be printed out on any of the 88 typebars, and unwanted zeroes can be automatically eliminated.

The calculating unit of the 420 consists of 80 net balance counter positions in 16 groups, which may be combined as desired. Progressive totals can be printed out from all counters, and from any counter on to any typebar. Amounts from individual cards, or totals from groups of cards can be crossfooted, either before, after, or during the print out.

Ancillary to the calculating unit are two storage units with 32 storage positions each (32 digits or 16 letters); a selector unit with 92 selector positions; and a special program device, allowing for minor, intermediate and major program controls. A feature of the 420 is a single or dual feed tape controlled carriage for accurate spacing, and for independent feeding of two different forms.

The IBM 421

This is a modified version of the 420 with a higher print out speed and other improvements.

Card reading speed: Up to 150 cards per minute. Addition, subtraction and accumulation of totals can be carried out at this speed, though card handling speed drops with the amount of printing that must be carried out.

The Line Printer: This consists of 100 typebars, each comprising the 26 letters of the alphabet, the numerals 0–9, and one special character. The printing speed for the early models of the 421 was 100 lines per minute, but for the latest model up to 150 lines per minute. Multiple line printing allows up to three lines to be printed from one card, as well as five classes of totals on up to five lines simultaneously, as required. Any counter position can be printed from any type bar.

The calculating unit of the 421 comprises 120 net balance counters in 22 groups grouped in almost any sterling or decimal combination by control wiring. Several amounts punched in a single card, and totals from groups of cards, can be crossfooted.

Ancillary to the calculating unit are four 32 position memory units; a selector unit comprising 15 four-position class selectors and six 10-position pilot selectors; a four-digit co-selector, a digit emitter and filter; a four-digit selector; and a control unit which allows operations to be performed at each of 20 program steps. The 421 has the same single or dual feed tape controlled carriage as the 420.

The IBM 444

This machine is intended for tabulator users who do not need such extensive accumulating, storage, or printing facilities, as is offered by the 421.

Card reading (and data accumulation) speed: up to 150 cards a minute (up to 100 cards on some models).

Line Printer: This consists of 56 type bars, 28 of which are numerical (the digits 0–9 and a special symbol —an asterisk or credit symbol)—and 28 alphanumeric (each having the 26 letters of the alphabet the digits 0–9 and a special symbol). Printing speed of the 444 is given as 100 lines per minute. A print out can be obtained from any one of the counters of the calculation unit, and four classes of totals can be printed out in up to four lines, as required.

The calculation unit consists of 40 direct subtract counters, of which half are also net balance counter positions. Progressive totals from any of the counters can be obtained.

Ancillary to the calculation unit is the selector unit, which has 48 selector positions; two 10-position and seven four-position pilot selectors; a storage unit with a capacity of 32 storage positions; and a program control unit which allows for up to 10 program steps.

The ICT 915

Card reading speed: (from two reading or ' sensing ' stations): 150 cards per minute. A further optional sensing station can be fitted, to deal with the card mix of single and multi-card groups, enabling the single cards to be detected and listed directly, thereby bypassing the cycles necessary with multi-card groups.

Line Printer: This consists of a print bank of up to 120 individually controlled print wheels, grouped according to customer requirements. Each print wheel can have 49 characters, 27 alphabetic—including the ampersand—12 numeric and 10 special symbols, subject to customer specification. The printing speed is given as 150 lines per minute.

The calculating unit consists of a maximum of 120 counter wheels in 28 groups, with three, four or six wheels per group. Groups can be interconnected to five any desired size of counting mechanism. The 12

four-counter groups can be specified to handle sterling, weights, fractions, etc, and decimal notation can be catered for by standard counter groups. Direct subtraction is available for all counters. A total rolling feature gives complete adding, cross-adding and subtracting between all adding mechanisms.

The selector unit on the 915 automatically selects, positions and identifies debit and credit balances.

Programming is by control panel plugging, but comparison control—major, intermediate, and minor—are carried out by control columns on the card, up to 20 positions being available, applicable to any column of the card.

An important optional feature of the 915 is a memory storage unit—a mesh assembly of ferrite cores with a capacity of 100 storage positions—which can be cable connected to the rear of the tabulator. The unit is able to receive data from both cards and counters, and emit to print unit, counters, or to a summary punch, where that is fitted; storage can be selective and emission repetitive, according to program.

The ICT 902

This tabulator, the forerunner of the 915, also incorporates many of its features. Card reading speed is 100 cpm when printing, 200 when adding. Printing is at 100 lines per minute. The print bank consists of 100 individually controlled print wheels, grouped according to requirements. The calculating unit consists of up to 100 counters, arranged in groups, four counter groups of two positions, 13 of four positions, and five of eight positions. Direct subtraction is available up to a maximum of 60 positions.

Program Control is through the plugboard panels, and the three types of control, minor, intermediate and major can be maintained through up to 16 positions on the punched card itself.

The other optional features of the 915, the multi-read control feature and extra sensing station can also be incorporated on the 902.

The ICT 906

This tabulator corresponds to the 902, save that it is for numerical data processing only. The card handling speed of the 906 is 200 cards a minute, with print out at up to 200 lines a minute.

In addition to the electronically operated tabulators, as shown above, there are a number of electro-mechanical tabulators, in the ICT 21-column and 40-column range, the ICT 810, 816, and 817, the 817 being a development of the 816. Since the two have so many features in common, the description of the one can apply equally to the other.

The ICT 817

This tabulator has a card-handling capacity of up to 100 cards per minute, though if continuous sheet feed is used this falls to 80 cards per minute. The print unit consists of 60 members, each member constructed to print the whole alphabet, numerals 0–9, and special characters, a total of 40 alphanumeric and 20 numeric characters.

The control and actuating mechanism is directed by a factory prepared connection box, which connects the sensing and recording mechanisms of the tabulator. The printing and adding mechanisms of the tabulator through the holes in the cards. Printing is from metal type through a ribbon, allowing roll paper, interfold paper, sprocket punched stationery and carbon sets to be used.

The ICT 21-column tabulator (type 810)

The 21-column tabulator is similar to the 817, save that it has only 25 members in the print unit. Its card handling speed is up to 125 cards per minute.

ANCILLARY PUNCHED CARD EQUIPMENT IN COMMON USE

Though the basic punched card tabulating operation can be carried out with only the foregoing equipment *ie.* card punches, card verifiers, sorters, and tabulators (accounting machines) it is usual also to make use of certain ancillary punched card equipment to carry out additional functions, and to simplify procedure for the operator. It is often customary to make a duplicate set of cards, to avoid the danger of losing data through some mishap to one or more of the cards in the set, and also to allow for replacement when cards which are constantly used become soiled; this is the basic function of the reproducing punch. It is often convenient to print out on the cards the data contained in the punching; this is done by an alphabetic interpreter: in the sorting operation it is often necessary to merge two packs of cards, putting detail cards behind the related summary cards. And, what is probably most important, it is often necessary to the tabulating run itself that as well as the printed list, further cards should be produced containing the updated information, which become the master cards for the next computer run. This is done by linking to the tabulator a summary card punch, which will operate as a ' slave ' under control of the tabulator plug-board panel, though it may be able to assist in field selection through its own plugboard panel.

SUMMARY PUNCHING FROM THE TABULATING OPERATION

As in the case of the earlier equipments the summary punching operation relates to a machine function, rather than a type of machine; that is to say it can be performed by more than one type of punch. Just as the

interpreting function can be performed on the latest automatic keypunches, and collating by the fastest sorters, so the summary punching operation can be carried out by a reproducing punch. The so-called summary punches also can do the work of the reproducing punches, being linked to a add-listing accounting machine to produce cards as a by-product of the accounting function, and being used also for gang punching.

However, there are seven punches which are specifically designed to operate as summary punches, and these comprise in the 80 column range, the De la Rue Bull PRD, the IBM 523, 526, 528, and the ICT 234, also there are two ICT Powers summary punches for 21 column and 40 column cards.

The De la Rue Bull SP

This summary punch is cable connected to 534/535 tabulators, and operates under control of its program unit. The matrix of 960 punching knives allows all columns of 80-column card to be punched simultaneously, at a speed of 75 cards per minute. The field selection for punching is dictated by the plugboard on the tabulator, but extra programming of field selection can be provided by the plugboard of the punch.

The summary punch may accommodate any degree of complexity in output, and two or more summary cards may be produced if data overspill the capacity of an 80 column card. The operation of the summary punch does not slow down the tabulator, as the punch has its own recording device. Summary cards are produced automatically at every sub-total or grand total of the tabulator, or when the tabulator has built up a summary which requires a follow-up.

IBM 523

This is a gang summary punch which can be cable connected to a tabulator for summary punching, or using its independent power supply can serve as a gang punch in its own right. By utilising the plugboard panels on both the tabulator and the punch, it is possible to carry out both accumulated total punching and gang punching simultaneously. The speed of punching, in each case is 100 cards per minute. Eight column splits are also available.

The punch is able to incorporate as optional features, an auxiliary card counter, one or two 10-position selectors, and up to 30 positions of double punch and blank column detection.

IBM 526

This equipment, known as the Printing Summary Punch, is designed for the smaller tabulating installation. Attached to an accounting machine it is able to operate at 17 columns per second, and in addition to punching details on the summary card it can put the data simultaneously along the top edge of the card.

The 526 is thus able to be a card interpreter, or gang punch, or even a manually operated card punch. There are two models of the 526, one having a numeric keyboard and one a combined alphanumeric keyboard.

The IBM 528

Though this machine is basically a reproducing punch—it is known as the Accumulating Reproducer—it can operate in conjunction with a tabulator, summary punching at 100 cards per minute.

The machine is equipped with its own accumulating counters—a maximum of 48 are available—and is able to add, subtract, and carry out balancing and self-contained summary punching. Totals from cards can be accumulated at a speed of up to 200 cards per minute. Gang punching and information reproduction can also be carried out, and the machine incorporates an automatic punching check which is carried out simultaneously with the punching.

The ICT 234

This machine, a gang summary punch, is developed from the ICT 202 reproducing punch, and can be connected to the 902 or 915, punching out into ' new balance ' or summary cards the quantities and values standing in the tabulator at predetermined stages in processing. This operation is carried out without interrupting the tabulating operation.

The punching unit consists of six punch ' x ' brushes which can be set as required; a series of 80 punching dies, one for each column of the card; and a series of brushes for reading the new card in comparison with the original. The punch, disconnected from the tabulator, can act as a gang punch. Gang punching of the common data, such as the date, etc, can be carried out during the tabulating run automatically. The speed of gang punch and/or summary punching is 100 cards per minute.

ICT 40 column and 21 column punches

Summary punches corresponding to the 40 column and 21 column tabulators are also available.

ERRATA

Reference was made last month to the IBM 084 punched card sorter. The speeds of this sorter was given as 2000 cards per hour. It should, of course, have been 2,000 cards *per minute*. Another IBM sorter—the 082—was unfortunately not mentioned in the section reviewing card sorters. The 082 sorter, operating at 650 cards per minute for each column sorted, is a current production model.

WHAT'S NEW

in systems, services and equipment

Disc Store with multi-arm access

A magnetic disc storage unit working on the principle of 'comb access', an access arm being provided for each disc surface, has been designed by IBM for use in conjunction with 1410 and 7000 series computers. This system, known as the *IBM* 1301, allows for a data transfer speed between the storage unit and the computer very much greater than that afforded by magnetic tape units.

The basic difference between this method and earlier random access storage units is that whereas under the old system one, two or three access are serviced the whole file of magnetic discs, moving up and down from disc to disc as well as in and out from track to track, under the new system 40 access arms move in unison to read and write data on the 250 concentric tracks on each of the 40 disc surfaces. In this way the storage unit becomes, in effect, a nest of 250 cylinders each holding up to 112,000 characters. Access time with a cylinder is 0–34 and between one cylinder and another 50–180 milliseconds.

The total storage capacity of the 1301 is 56 million characters. Access time between the storage unit and the 1410 is given as up to 75,000 characters per second, and between the unit and the 7,000 series is 90,000 characters per second. Up to five storage units can be connected to the computers giving a total storage of up to 280 million characters. The longest time it can take to obtain a record from the whole 280 million characters is 214 milliseconds.

For further details tick HO1 on the reader enquiry coupon on page 43, or write to:
IBM United Kingdom Ltd,
101 Wigmore Street,
London, W1.

Embossed plates activate punching/interpreting

BEING marketed in this country for the first time—though widely used in America—is the Addressograph-Multigraph 9300, a card preparation equipment which combines the function of a reproducer punch, alphabetic interpreter and verifier.

This equipment enables information embossed in an addressograph plate, the name and address of a customer and other variable data, to be reproduced automatically on an 80-column IBM card. The plate has a matrix containing up to 27 digits of information corresponding to the information embossed on the card. Thus up to 40 columns of punching can be entered on the card, and up to nine lines of alphabetic and numeric information. The date, and other coded fixed information can be punched automatically on to cards, using a punched mechanism set up by the operator. Consecutive numbers, signatures relating to cards etc, are imprinted automatically.

These operations are carried out at a single card pass, at a speed of more than nine hundred lines per minute. The equipment has a particular application production control and data collection, where the punched card acts as a source docket. However, it will become even more essential should the American systems of punched card cheques, dividend warrants, and public utility billing become standard practice in this country. The cost of the system, depending on the facilities required will vary between £17,000–£25,000.

For further details tick HO2 on the reader enquiry coupon on page 43, or write to:
Addressograph-Multigraph Ltd,
Maylands Avenue,
Hemel Hempstead,
Herts.

Checking digits before punching

A SMALL solid state digit verifier for checking by-product tapes produced from accounting machines and add-listers is announced by Burroughs.

The digit verifier, known as the A570, is cable connected to the accounting machine, and carries out the calculation-agreement function in the split second between the performing of the calculation on the machine and the punching of the results on the tape. Thus the intervention of the verifier does not slow down the calculating or punching function; should an error be detected punching will be prevented.

The check digit is obtained by performing a predetermined calculation on the number and adding the product of such calculation as the final digit of the number. This formula is programmed on to the verifier, which carries out the calculation for each account or reference number. The A570 can be used in conjunction with both tape producing and card producing machines.

For further details tick HO3 on the reader enquiry coupon on page 43, or write to:
Burroughs Machines Ltd,
Avon House,
356 Oxford Street,
London, W1.

Multi-channel Sorting by Selector

A DATA selector unit which when coupled to an input reader—card, tape, or magnetic tape—allows selected data to be read out on up to 10 output channels is announced by Ultra Electronics.

More than nine on-line

The input device can be a high speed card or tape reader or magnetic tape unit, operating at up to 15,000 characters per second. Throughput of information must depend on the speed of the various output media. These can be reproducing paper or card punches, add-listing machines, or electric typewriters.

A typical application would be where a number of tapes from various outstations—by product tapes from cash registers, etc—are combined and it is required to produce a detailed list of sales of particular lines. Each of these lines would be precoded. The 10 selector switches on the selector unit would be set to receive the appropriate two-digit selector code for the various products. The paper tape reader would read through at top speed until a selector code was detected. A matrix mounted on slide-in circuit boards in the selector decodes these input codes and allows the particular output channel to be selected. Information can then be reproduced, as the 64 lines of the selector channel have been assigned on a typewriter or punch, or accumulated on an add-lister.

If paper tape reader is used as input, the selector can accommodate 5-, 6-, 7-, or 8-channel coded tape.

Selected information from one tape can be punched on ten different by-product tapes, as required.

For further details tick HO4 on the reader enquiry coupon on page 43, or write to:
Ultra Electronics Ltd,
Western Avenue,
Acton, W3.

For joining short runs

TABULATOR runs frequently end, leaving some ten or twenty sets of continuous stationery unused. This is too much trouble to reload on the machine and so these ends of sets, perhaps costing up to twenty shillings, are discarded. Stationery manufacturers Fanfold Ltd have devised a machine which, by attaching the remnants to a new pack, ensures they are utilised.

This equipment, known as the Continuous Form Joiner, consists of two items, a set of adhesive strips, backed with paper; and a special board on which the forms can be brought together for attachment. The board consists of a raised plastic

Means to save pack ends

'table-top' with on the left-hand side four fixed sprockets set in line. Down the centre of the board runs a worm wheel, attached to which are two movable sprockets. These two are set in position so that they will engage with the right-hand sprocket. The strip, at one end of which are two sprocket holes is placed along the centre. Next the sprocket holes of the two sets to be joined engage with the three upper and three lower sprockets—two on the left and one on the right and the forms are thus brought into juxtaposition. A simple pressure of the finger along the form enables the adhesive strip to attach to the two forms, which are thus joined together.

There are two sizes of joiner available, for forms up to 14 inches wide, and for forms up to 18 inches wide. The cost of the joining board in the former case is 30 guineas and in the latter 45 guineas. The self-adhesive strips cost 30s. per hundred, with proportionate reduction for larger quantities.

For further details tick HO5 on the reader enquiry coupon on page 43, or write to:
Fanfold Ltd,
Bridport Road,
London, N18.

Instant Cash Analysis

A COUNTER posting machine designed for savings banks, hotels, when an immediate breakdown of cash taken is required has been developed by Burroughs. This machine, the Sensimatic F.760, enables accounting records to be posted as soon as cash is received. Individual accumulating mechanisms on the machine allow for immediate analysis by ledger heading, type of transaction area, cashier, etc, or other account breakdown; the required analysis is controlled by keyboard selection.

Read out facilities for punched

cards or punched tape are also available on the F.760, under control of the sensimatic control panel. It is thought that garages, stores, and hire-purchase concerns, as well as local government applications such as rent collection.

For further details tick HO6 on the reader enquiry coupon on page 43, or write to:
Burroughs Machines Ltd,
Avon House,
356 Oxford Street,
London, W1.

For filing unburst forms

A LOW cost transfer binder, which allows up to 500 unburst forms to be filed with easy access to each sheet, is announced by Copeland Chatterson. The binder consists of a stout manilla file, made to the specifications of the customer in respect of size and colour, with two metal tipped elastic cords attached to the binder via a series of eyelets which adjust the tension of the cords to the number of forms filed. The cords are inserted in the two corner sprocket holes of the continuous forms, which are thus held firmly in position and can be opened flat at any form. The hinge of the forms is thus not the sprocket holes but the perforated edge of the forms. The makers say that with the system every line of every form in the set is completely visible, and completely flat opening is possible at every form.

Cost of the binder which can be ordered in quantities upwards from 50 works out at somewhat less than fourpence for every 100 sheets filed. Guide tags for locating particular sheets are incorporated as a standard feature.

For further details tick HO7 on the reader enquiry coupon on page 43, or write to:
The Copeland-Chatterson Co Ltd,
Gateway House,
Watling Street,
London, EC4.

Erratum

Mention was made in the July issue of the IBM 108 card proving machine. The cost of this machine was given as £900 and the rental costs £17 per month. This should in fact have been £6,875 for the outright cost. and £137. 10s. for the monthly rental.

The Role of the Accountant

Continued from page 22

The fourth requirement, the ability to provide information at the earliest useful time, is one of the most important changes that has taken place. In the past, there was a great deal of information management wanted which could not be economically compiled in time to be of use. This has been changed by the new hardware. The assembly of some 100,000 freight transaction records received daily, updating of 105,000 master records for cars on and off line, and selection of data for reports to be available on officers' desks when they come in each morning, now takes only five hours of computer time. It soon will take less. Under old methods it just could not have been done. Statistics used to be a matter of history. Now they can be news. We used to produce gross ton miles per train hour, a useful indicator of operating performance, three weeks after the end of the month. Now we can provide yesterday's figures at the opening of business today as a by-product of other processing. Other information can be produced to plan present action, rather than to measure past performance.

The fifth is the production of selected information that will require a minimum of further human manipulation to achieve maximum objectives. The problem here is to use the capacity of the computer to select useful data requiring attention instead of printing out voluminous reports demanding extensive human work to ferret out such data. A readily understandable example of this is the production of a statement of inventory items in over or short supply instead of a complete listing of all inventory items.

In using the new tools to provide better management information, we can also make more extensive use of techniques of statistical analysis and cost analysis which have been known for years. Some of these can be done, with considerable labour, without the aid of a computer. Comprehensive, accurate and timely information now available, joined with the capacity of the large computer, make it possible to use such techniques in areas not heretofore practical. For example, evidence on the cost of handling grain, presented to the MacPherson Royal Commission on Transportation, was based on the most intensive analysis of railway costs that has ever been made. These studies were made on the computer using multiple regression analyses. They were concrete evidence to our management of the value of the new tool.

The computer can also be used to simulate physical operations as an aid in the solution of business problems. One technique involves building mathematical models using various assumptions to determine those which would give the most favourable result.

We have used this successfully in simulation of train performance, using data for different types of motive power as a basis for setting tonnage ratings and determining schedules which would give the best relationship between speed and fuel consumption; also in the design of hump yards and centralised traffic control layouts.

Recently, I attended the 12th International Conference of an organisation called 'Guide', which brings together the top EDP representatives of some 300 organisations with large scale IBM digital computers. This year, one could judge from the sophisticated papers presented, that the horizons are still widening and useful accomplishments are increasing. In a large company, there are only a few people who combine experience in systems analysis with knowledge of a segment of the company's procedures. In the present state of the art, there are few systems analysts who have a wide knowledge of all the new techniques. The art has moved so fast that those working in it have as many specialties as there

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The Role of the Accountant

Continued from page 41

are different specialties among medical doctors.

This will demand a high degree of preparation. Accountants, more than other departmental users, must study the tools—the capacities of the machines, what they can do and what they can not do. It is not just a matter of memorising the speeds at which a given computer can perform additions and subtractions or make logical decisions. It means learning how the computer works, acquiring a sound general grasp of how the many streams of data that constitute input are processed through to produce the almost infinite variety of outputs.

To learn the tools is one thing. To bring creative and imaginative thinking to their use is something else again. Here, beyond doubt, is the greatest opportunity and the greatest challenge. It is not easy to discard traditional approaches and traditional uses. For some of us, at least, it is not easy to overcome our fear of the unknown and we are prone to fall back on the old ways or, equally futile, to be satisfied with the old results. Reading, attendance at seminars, discussion with others, will all be required to broaden one's experience and confidence.

At the other extreme, one could be over enthusiastic. There is a temptation to use the computer to do things that need not be done, just because the doing of them is possible—to demand *complete* information when selected information, or more sophisticated combinations, would suit the purpose better.

For the accountant, the blueprint is clear. He is going to have to master the new technology, to know more and more about more and more things, and to distill those elements of business intelligence that will best contribute to efficient operation. He must share in building the new system to provide them.

This will demand hard work—the ability to throw off the not unnatural conservatism of many accountants. It will require patience: the careful planning required must be measured in years, not months, and results will seem slow in coming. It requires courage: computer rentals and computer costs are high, yet they are only one element—indeed, the costs and systems design effort associated with data collection and data transmission are often substantially more costly than the computer itself. Above all, it will require vision—the vision to design an overall system and fit the pieces in one by one to provide for the total corporate requirements of the firm.

There are therefore two tasks ahead. The first—for a small core of specialists and general practitioners—to try to keep abreast of the best technical and systems developments in this rapidly maturing field. The second—for a wider group to endeavour to take advantage of and incorporate these new techniques in day-by-day operations as rapidly as possible. These are not easy tasks. The first requires hard working men of wide vision, quick absorption, initiative, judgment, per-

severance and many other attributes. The second requires similar aptitudes. By the nature of things, for their main duties, other aptitudes are also essential and it is probable that the ultimate goal will not be effectively accomplished until a completely new generation of managerial and supervisory personnel has grown up with EDP.

There are some who think the small group of specialists and general practitioners, as I have called them, can themselves plan for and provide the better business intelligence which is required. They can help, but I am convinced that it is much easier to teach a wide group of people the new techniques than it is for any small group to acquire the diverse knowledge and experience of company operations necessary to fully exploit for management the type of use of data processing facilities which will be routine 10 years from now.

When such a wide group know what can be done they will be able to recognise many places where innovations could be profitably adopted. It is, of course, a joint effort of both groups, but all my discussions with others in this field indicate the danger of leaving the initiative to the systems analysis personnel. This might be tolerable were only systems at stake, but the present revolution goes much farther and will only mature when management itself takes the lead in specifying the new types of information it can advantageously use from the almost unlimited reservoirs of timely data now available.

I have probably said enough to make the point that we are dealing with an entirely new basis for the development and provision of management control information. Over the years this control information has followed well defined lines due to time and cost factors inherent in the old systems. It will take a great deal of trial and error work by a lot of people to devise the new pattern which must emerge because of the change in time and cost factors that has taken place.

The modern integrated data stream involves the initiation, transmission, processing, compilation, retrieval and effective use of control information. The accountant has his traditional role to play in seeing that the data in this stream and the way in which it is handled fully meets accounting requirements.

There is, however, the still broader role which I have already dealt with at length. The accounting function gives company accountants a good overall picture of the flow of information through a company, of all the various requirements of management, of corporate responsibility to provide information to shareholders, and of statutory requirements. Through experience of manual accounting, they know the prime sources of many of the multitude of entries which go to make up a company's records. Better than any other group within the company, their training and experience qualify them for a leading role in the planning and development of an integrated system of data processing.

As you will notice, for the reasons previously outlined, I was very careful to say *a* leading role, not *the* leading role. The development of an integrated system requires experience and skills drawn from all departments, and an appreciation on the part of all who work on it that their responsibility is companywide, not departmental.

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Honeywell Controls Limited,
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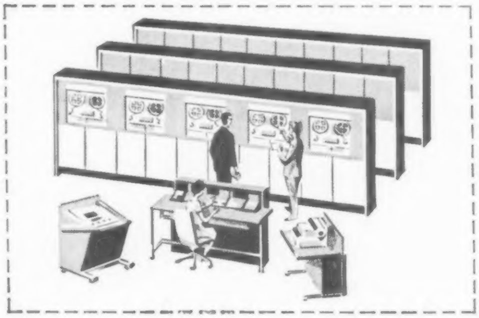

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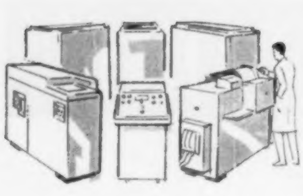

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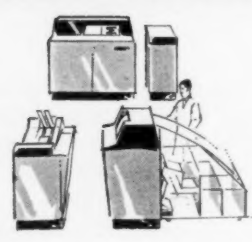

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